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VOL. 36. Ser. A. Part 10. pp. 309-348. OCTOBER, 1948.

THE REVIEW OF APPLIED ENTOMOLOGY.

SERIES A: AGRICULTURAL.

ISSUED BY THE COMMONWEALTH INSTITUTE OF ENTOMOLOGY.

LONDON:
COMMONWEALTH INSTITUTE OF ENTOMOLOGY,
41, QUEEN'S GATE, S.W.7.

Price 4s. net.

Head Office—British Museum (Natural History), Cromwell Road, London, S.W.7.

Publication Office and Library—41, Queen's Gate, London, S.W.7.

DUMBLETON (L. J.). **The Red-legged Earth Mite. Measures for Control of Pest and Protection of Vegetables.**—*N.Z.J. Agric.* **74** no. 1 pp. 9, 11, 13, 3 figs. Wellington, N.Z., 1947.

Halotydeus destructor, Tucker, was first observed in New Zealand in 1942, when it was found attacking vegetables near Napier. Surveys made in 1945 and 1946 showed that it occurs over a wide area at Napier [*cf. R.A.E.*, A **36** 244], in a smaller area near Gisborne and in Wairoa. Notes are given on its appearance, including the difference in coloration distinguishing it from *Penthaleus major*, Dugès, which occurs throughout New Zealand, and on its life-history and food-plants in Australia [*cf.* **34** 162, etc.]. It feeds on a wide range of wild and cultivated plants ; in New Zealand, the principal damage is to such plants as french beans germinating in spring and tomatos immediately after being planted out. Potatoes appearing above ground may be stunted and blackened, but once growth has begun, they recover from the effects of mite damage. Other vegetables that have been injured in New Zealand include broad beans, peas, asparagus, silver beet and marrows.

Areas of waste ground in or near gardens should be reduced to a minimum, especially if they carry rough and weedy growth in which the mites can shelter and feed. Where such areas cannot be cleared, or where infested pasture adjoins the garden area, the latter should be protected by a treated barrier strip ; the best material for treatment has not yet been ascertained. To reduce the number of mites in the garden before planting, the whole area should be treated with dusts or sprays or with a poison bait [**32** 262]. A spray prepared from waste tobacco has given fair results, and work in Australia has shown that dusts containing 2 per cent. DDT or gammexane [γ benzene hexachloride] give good control [*cf.* **35** 158]. Preliminary work in New Zealand in October–November 1946 indicated that effective control can be obtained at reasonable cost with sprays of 1 lb. wettable DDT powder (20 per cent. DDT) per 100 gals. water, a 1 per cent. emulsion of a 3 per cent. solution of DDT in oil, or 3 fl. oz. nicotine sulphate and 12 fl. oz. white oil in 10 gals. water, or with a 2 per cent. DDT dust. A dust containing 4 per cent. gammexane and a spray of 1 lb. of a dispersible powder containing 5 per cent. gammexane per 100 gals. water gave good control but tended to cause some plant injury. Plants in infested ground should be protected with a dust or spray as soon as they germinate or are planted, and it may be necessary to dust or spray the whole area of crops such as peas in order to kill the mites on the ground rather than on the plants. As the deposit on the soil is probably of major importance, it should be disturbed as little as possible for a week or two.

CALDWELL (N. E. H.). **Stored Product Pests in northern Queensland.**—*Qd J. agric. Sci.* **4** no. 1–2 pp. 7–11. Brisbane, 1947.

A survey of the pests attacking stored products under war-time conditions in north-eastern Queensland was carried out in 1942 and 1943, and supplementary observations were made in the next two years. The commodities examined comprised whole, cracked and crushed grains, processed and milled cereal products, leguminous seeds and seed products, dried fruits, nuts and nut meats, tobacco and other dried plant products, and dried meats ; factory and warehouse débris was also inspected. Upwards of 30 insects, mostly Coleoptera, were found. The types of material infested by each pest, with ratings of the severity of the infestations, are shown in a table. The species of most importance were *Tribolium castaneum*, Hbst., and *Corcyra cephalonica*, Staint., followed by *Calandra oryzae*, L., *Oryzaephilus surinamensis*, L., and *Ephestia cautella*, Wlk. *T. castaneum* occurred most frequently and abundantly in milled cereal products [*cf. R.A.E.*, A **36** 68] and rather less so in crushed

and cracked grains, processed cereal products and factory débris, and was also found in whole grains and nuts and nut meats. *Corcyra cephalonica*, which had not previously been regarded as a major pest in Queensland and has not yet been recorded in the southern part of the State, attacked all the types of materials examined to varying degrees, but was most abundant in cereal products. It and *Dermestes* sp. were the only insects found in dried meats, both in small numbers. *Calandra oryzae*, L., of which only the large strain [*cf.* **34** 21] was found, infested grain, cereal products and débris, *O. surinamensis* occurred in all the materials except leguminous seeds and dried meat and was most abundant in processed cereal products, dried fruit and nuts and nut meat, and *E. cautella* infested grain, cereal products, leguminous seeds and seed products, dried fruit and débris. Only one mite (*Thyreophagus entomophagus*, Lab.) was found and it occurred only in milled cereal products in small numbers. Some small mite infestations may have been overlooked, but the characteristic musty odour of such infestations was not observed, and it is therefore concluded that mites are not of general importance. The superiority of wholemeal flour to white flour as a breeding medium for many insects [*cf.* **32** 185] is thought to be of little practical significance in northern Queensland; large populations of certain species, notably *Tribolium castaneum* and *Corcyra cephalonica*, will quickly develop in white flour in the tropics. Initial contamination, the risk of which must be greater in the case of coarse-ground materials, is considered to be of more importance in determining the rate of deterioration caused by insects. No correlation was found between the distribution and density of the principal species and the four main climatic zones (wet and dry coastal, wet subcoastal highland, and dry inland) involved in the survey.

HEM SINGH PRUTHI & PRADHAN (S.). **Methods of computing Pest Incidence.**—*Indian J. agric. Sci.* **15** pt. 5 pp. 265–269, 1 fig., 10 refs. Delhi, 1946.

The authors point out that methods of estimating insect populations often have to be devised hurriedly and without due regard for their scientific accuracy, when the immediate control of an outbreak is the main consideration, and that if such methods are later published, they are likely to be adopted by other investigators who overlook the fact that they are defective. They therefore emphasise the desirability of calculating the incidence of pests or parasites with reference to a fixed scale. In the case of crop pests and their parasites, a unit area of land on which the crop is grown provides a fairly good and constant scale; where it is necessary to record incidence as percentage of plants or plant parts (fruits, etc.) attacked by a pest or of hosts attacked by a parasite, the average number of plants, plant parts or hosts per acre should also be recorded, so that the incidence of the pest or parasite may be referred back to the fixed scale of unit area for comparison with future records. The authors illustrate their remarks with reference to their own and other investigators' work on cotton pests in India.

HAROON KHAN (M.). **Some Field Observations on the present Cycle of Desert Locust** (*Schistocerca gregaria* **Forsk.**) **in Sind.**—*Indian J. agric. Sci.* **15** pt. 5 pp. 270–274, 9 refs. Delhi, 1946.

Observations on the behaviour of *Schistocerca gregaria*, Forsk., were made in the Thar desert in south-eastern Sind in 1941 and 1943, during the outbreak that began in 1940 [*R.A.E.*, A **29** 519–520; **30** 303]. The desert receives most of its annual rainfall (7–14 ins.) between June and October. *Pennisetum typhoides* is the principal crop and *Sesamum orientale* (*indicum*), *Phaseolus aconitifolius* and *Cyamopsis psoraloides* are also cultivated, but the land is chiefly used as pasture. During July and August 1941, many swarms of locusts flew

across parts of Sind, generally in a south-easterly direction. Rainfall was considerable during these months, and oviposition took place over the entire desert tract in Sind. The eggs were laid in planted and fallow arable land, on mounds of sand near perennial bushes, which were preferred, and, rarely, in thick annual vegetation. Heavy floods in North Sind during July 1942 were followed by oviposition in February–March 1943 in two non-irrigated districts that are normally unsuitable. Heavy showers in parts of the Thar desert in July 1943 again enabled oviposition to take place over a wide area. One ovipositing swarm moved from north to south over a distance of 80 miles; oviposition was heavy in the north, but decreased towards the south, where it ceased. Hatching began on 10th August in the north and about ten days later in the south.

Conditions of light and heat are very similar over thousands of square miles in the Thar desert and it is therefore doubtful whether these factors have any direct influence on the formation of hopper bands. The physical features of the area appeared to be of importance, since bands moving towards the same spot frequently fused. In general, the bands were composed of hoppers in only one or two instars, but bands containing all five instars, with the last three predominating, were observed on several occasions. Most of the large bands included a small percentage (less than 1) of hoppers in the solitary phase, and some adults in either the solitary or gregarious phase were always present in bands of fifth-instar hoppers. The areas covered by the bands varied from a few hundred square feet to several square miles; bands of young hoppers were usually small and those of older ones large. The hoppers were in general less than ½ in. apart in the morning and evening, but as much as 1 in. or more during the day. The bands sometimes became split up by the passing of cattle or because some hoppers remained behind to moult or moved away in search of food when all the available vegetation had been consumed. It is suggested that the term "band" should be restricted to a group of hoppers moving in the same direction and occupying an area of 200–400 sq. ft., in which most of the hoppers are not more than 2 ins. apart. The bands were active from about an hour after sunrise until about an hour before sunset. In general, they followed the direction of the wind and took the easiest route over the sand-dunes. Their speed varied considerably; a band of first-instar hoppers was estimated to travel about ¾ mile in one day. Fifth-instar hoppers leave the bands to moult, and the adults, on emergence, join any passing band and remain with it, probably for not more than 2–3 days. Adults comprised 1–5 per cent. of the individuals in large hopper bands and 20–50 per cent. in small ones; two very small bands in a highly infested area consisted almost entirely of adults. After a time, the adults left the bands by gathering on bushes and plants, which appeared to be the first step in the formation of primary swarms, or by joining swarms that passed overhead. In September 1941, small primary swarms were observed hovering near their place of origin 4–7 days after the adults emerged. These swarms were joined by others, and loose swarms, capable of flying a mile or more at a time, were observed about a week after the emergence of the adults.

Migration from the Thar desert began rather earlier than usual in 1941 owing to warm weather. Summer-generation adults became numerous during September and the first two weeks of October and reached parts of Sind 150–200 miles away about a fortnight later. Large numbers of swarms were reported from various parts of Sind in the last week of September and during October. Swarms were observed flying when shade temperatures were as low as 55°F. and as high as 110°F. Most of the common plants growing in the desert were attacked by the hoppers and adults of the gregarious phase, but the adults showed a preference for the seeds of *P. typhoides*. Cannibalism was not observed in the Thar desert, but occurred under hot, dry conditions elsewhere. Damage to pasture was very heavy in 1941, and losses of crops were estimated

at about 75 per cent. ; in 1943, when infestation was relatively mild, most of the damage was due to hoppers. Of the species of birds recorded as enemies of locusts by Husain and Bhalla [**20** 209], 19 were observed in the desert during the infestation in 1943. Most of them were seen eating hoppers and some of them adults also. Only six are common, but of these, *Pastor roseus* attacked the locusts in flocks and was of great importance in controlling them in 1943.

Haroon Khan (M.), Ladha Ram Mohindra, Ganda Ram Sharma & Abdul Ghani (M.). **Studies on *Earias* Species (the Spotted Bollworms of Cotton) in the Punjab. IV. The Hosts and Host-preference of *Earias cupreoviridis* Wlk., *E. fabia* Stoll and *E. insulana* Boisd.**—*Indian J. agric. Sci.* **15** pt. 5 pp. 275–280, 17 refs. Delhi, 1946.

This paper is the fourth of a series [*R.A.E.*, A **34** 282, 287 ; **36** 120] on *Earias* spp. in the Punjab. *E. insulana*, Boisd., and *E. fabia*, Stoll, have been serious pests of cotton in India for 40 years, but *E. cupreoviridis*, Wlk., which is a pest of cotton in China [**25** 791] is not known to attack it in India ; the only record of its doing so [**13** 354] is considered erroneous. The destruction of alternative food-plants during the season when cotton is not available is often recommended as the only effective measure against *Earias* spp., and detailed observations to determine the importance of such food-plants in enabling them to persist in the absence of cotton were accordingly made in the Punjab in 1934–36. Larvae of the three species were collected from the flower-buds and pods of various food-plants in each of five cotton-growing areas at intervals of 7–14 days during the season and reared in the laboratory. Some 18 food-plants are recorded from various parts of India, but only 11 were attacked in the Punjab, and the material from *Sida humilis*, *S. rhombifolia* and *Urena lobata* was insufficient for conclusions to be based on it. The number of moths reared at different places and in different seasons and years from the other eight plants, which were *Abutilon indicum*, *Althaea rosea*, *Hibiscus cannabinus*, *H. esculentus*, *Malva parviflora*, *M. sylvestris*, *Malvastrum tricuspidatum* and *Sida cordifolia*, are shown in tables, and the results, with the status, habitat and seasonal history of the plants, are briefly discussed. *E. insulana* occurred on all eight plants, but appeared to prefer *Abutilon indicum*. It is the commonest bollworm in the Punjab, and its comparative lack of specificity may in part account for its wide-spread distribution in Africa and Western Asia. *E. fabia* attacked *Althaea rosea* to some extent, but chiefly *H. esculentus* ; it was very common during July–October, when pods are plentiful on this plant, and may attack cotton when populations have built up.

E. cupreoviridis occurred occasionally on *A. rosea* and *H. esculentus*, but mainly on *M. tricuspidatum* and *S. cordifolia*. Neither *E. cupreoviridis* nor its preferred food-plants are common in the Punjab.

Smith (K. M.). **Plant Viruses.**—2nd edn., $7 \times 4\frac{1}{4}$ ins., ix+78 pp., 8 pls., 3 figs., 102 refs. London, Methuen & Co., Ltd., 1948. Price 6*s*.

The subject matter of this second edition of a book on plant viruses resembles that of the first [*R.A.E.*, A **24** 261] in general scope, but the text has been completely rewritten to bring it up to date.

Whitehead (T.) & Wood (C. A.). **Virus Diseases of the Strawberry. I. The Field Problem in North Wales.**—*J. Pomol.* **22** no. 3–4 pp. 119–133, 2 figs., 26 refs. London, 1946.

A survey begun in 1938 showed that a decline in the yield of commercial strawberry plantations in the Dee valley in North Wales, which had caused the area under strawberries to be reduced from some 750 acres in 1914 to about 50

in 1945 was due to virus diseases. Since the viruses that cause the yellow-edge and crinkle diseases [*Marmor marginans* and *M. fragariae* of Holmes] are known to be transmitted by the strawberry Aphid, *Capitophorus* (*Pentatrichopus*) *fragariae*, Theo. [*cf. R.A.E.*, A **31** 142, etc.], investigations, which are described in detail, were carried out to ascertain the relation between Aphids and the degeneration of strawberry crops in North Wales. The nomenclature of *C. fragariae* and allied Aphids is briefly discussed from the literature [*cf.* **29** 27, etc.].

Examination of many strawberry plants of different varieties and ages showed that the percentages in which the three categories of degeneration (dwarfing, yellow-edge and crinkle) were severe were closely related to the intensity of infestation by *C. fragariae*. In 1940–42, when Aphid infestation and the spread of virus disease were relatively low, symptoms of degeneration were more severe in the older than in the newer beds of a particular stock, but in 1943–44, when Aphid infestation was high, degeneration of all beds was rapid and severe, so that there were no healthy runners available for propagating ; in August and September there were severe symptoms in 60–80 per cent. of the plants in stocks of the variety Royal Sovereign that had been free from virus nine months earlier. The symptoms differed with variety, and the differences corresponded with those observed in south-eastern England [*cf.* **27** 395]. Tables are given showing the relative sensitivity of the varieties examined.

The results of tests in 1938–41 with other possible Aphid vectors of the viruses are recapitulated [*cf.* **30** 322–323]. Further tests in 1944 confirmed that *C.* (*P.*) *tetrarhodus*, Wlk., which normally occurs on roses and has not been recorded on strawberry, is an efficient vector of crinkle virus, while *C.* (*P.*) *potentillae*, Wlk., a species restricted to *Potentilla anserina*, is not. Transmission tests with *C. fragariae*, in which healthy plants of wild strawberry (*Fragaria vesca*) were used as indicators, showed that the offspring of infective adults, whether the latter are alate or apterous, cannot transmit the crinkle virus before they have fed on an infected plant, but after doing so they can effect transmission at any stage of their development. Adults transmitted this virus after spending 1½ hours on an infected plant, and healthy plants contracted the infection after one hour's feeding by a single Aphid that had previously fed for not more than two hours on an infected plant. Thus the incubation period within the insect, if any, must last less than three hours and the virus is presumably of the non-persistent type [*cf.* **29** 26]. Tests of the infectivity of Aphids collected in the field in 1940 and 1941 indicated that *C. fragariae* can transmit the disease at any season, except perhaps when completely immobilised by severe cold, but many observations have shown that the greatest spread occurs during summer, when alatae are present and conditions are suitable for flight.

The crinkle virus was shown to remain infective in moribund leaves of diseased plants of Royal Sovereign, and symptomless carriers are infective, but newly infected leaves of wild strawberry did not become infective until symptoms began to appear in them. In 1939, when a wide range of possible food-plants was artificially colonised by *C. fragariae*, the Aphids lived and multiplied readily on *P. anserina*, and moderately well on *P. comarum*, *P. fragiformis*, *P. thurberi*, *P. nevadensis* and *P. sterilis*. No symptoms developed in virus transmission tests with all but the last species of *Potentilla*, and no virus could be recovered from the plants after colonisation by apterae that had fed for nine days on strawberry plants severely infected with crinkle. Grafting tests indicated that *P. anserina*, the only wild plant on which *C. fragariae* has been found in nature [*cf.* **26** 613 ; **29** 28], is immune from strawberry viruses, while *P. sterilis* becomes a symptomless carrier of one or more of them when artificially infected. The possibility of wild strawberry serving as a reservoir of the

viruses is considered remote, since though it is colonised and infected by *C. fragariae* where it is grown between rows of cultivated strawberry, the Aphid has not been found on it under natural conditions.

Control of the diseases should be based on the destruction of *C. fragariae*, preferably by fumigating with vaporised nicotine [*cf.* **30** 326], and the building up of virus-free stocks, so that foci of infection are eliminated.

DICKER (G. H. L.). **The Biology of the Apple Blossom Weevil,** ***Anthonomus pomorum*** **L.**—*J. Pomol.* **22** no. 3–4 pp. 140–152, 4 graphs, 10 refs. London, 1946.

Observations on the bionomics of *Anthonomus pomorum*, L. [*R.A.E.*, A **34** 273] were continued in Kent and Essex in 1943–45. Population counts, made by tapping all the outer branches of selected apple trees and catching the weevils thus dislodged on a tray, showed that adults emerge from hibernation over a period of about five weeks, beginning in late February or early March, but little activity was observed unless the maximum daily temperature exceeded 50°F. [*cf.* **31** 436]. At East Malling, Kent, the numbers of adults increased until the second week in April in 1943 and 1944, but reached a maximum in the latter half of March in 1945, which was an early season. The population remained high for a fortnight and then declined until the new adults emerged; these became most numerous in June each year, but were three times as plentiful in 1945 as in the previous years. Figures obtained in Essex agreed well with those from Kent except for the greater rapidity with which the population was built up in March 1944. This may have been due to the fact that the plot on which observations were made was near a bank where weevils hibernated. Adults of the new generation were occasionally observed to feed on young apples, causing superficial injury. Up to the time of peak emergence from hibernation, females comprised 60 per cent. of the population, but the sexes subsequently emerged in equal numbers. Oviposition in the young blossom buds began when the fruit bud reached the bud-burst stage and continued for three weeks. The progress of development of populations within the blossom buds is shown diagrammatically for each season and locality in which observations were made, the stage of the fruit bud (bud burst, green cluster or pink bud) being indicated in the East Malling records. Females that completed their oviposition period in the laboratory laid an average of 44·5 eggs each. Some collected from hibernation quarters in February and kept without food until 19th March oviposited on 23rd March. A few adults lived for two years, and females oviposited during the second year. No eggs were laid by unmated females.

When sacking bands were placed round the trunks of apple trees to study movement into hibernation [*cf.* **13** 61], the numbers of weevils trapped increased rapidly from mid-June until late July or early August and then decreased until September; a small amount of movement into the bands continued throughout the autumn and winter. A band of grease was applied as a barrier above or below the sacking on some of the trees in September 1944, and the subsequent collections showed that most of the weevils that entered the sacking late had come from the soil, probably because it had become too wet.

There were always 3–4 times more weevils on the trees in June of each year than in the following April. It is thought that mortality probably accounted for about 50 per cent. of the loss, and failure of many overwintered adults to return to apple trees in spring for the remainder. In the large woodlands near Maidstone, Kent, many hundreds of yards from orchards, the weevils can be tapped from rowan (*Sorbus aucuparia*) and hawthorn (*Crataegus oxyacantha*) throughout the oviposition period. Natural enemies were of little or no importance; 0·2–0·6 per cent. of large numbers of infested blossoms yielded *Ephialtes* (*Pimpla*) *pomorum*, Ratz. [*cf.* **6** 280], the only parasite

obtained, the pupae of the weevil had been removed from a few, probably by tits, and a fruit grower reported that wood ants (*Formica rufa*, L.) sometimes carry the immature stages away to their nests. The adults are sometimes attacked by the fungus, *Beauveria globulifera*, during the hibernation period.

DICKER (G. H. L.), GAYNER (F. C. H.) & AUSTIN (M. D.). **Control of the Apple Blossom Weevil,** *Anthonomus pomorum* **L.**—*J. Pomol.* **22** no. 3–4 pp. 162–174, 1 graph, 16 refs. London, 1946.

A detailed account is given of experiments with DDT, benzene hexachloride and other insecticides against *Anthonomus pomorum*, L., on apple in England, the main results of which have already been noticed [*cf. R.A.E.*, A **35** 211]. In the preliminary laboratory tests, two thiocyanate dusts at 0·5 per cent. active ingredient killed no weevils, and dusts containing 1 or 5 per cent. dinitro-o-cyclohexylphenol, 1 per cent. rotenone (as derris or *Lonchocarpus*) or 1 per cent. dinitro-o-cresol killed a negligible proportion (2–16 per cent.). Even undiluted *Lonchocarpus* root containing 5·7 per cent. rotenone gave only 83 per cent. mortality. Dusts containing 5 and 10 per cent. dinitro-o-cresol gave, respectively, 89 and 99–100 per cent. mortality, but exerted considerable phytotoxic action and therefore had to be rejected. The dinitro-o-cresol also appeared to stimulate oviposition, but instead of the eggs being laid inside the buds, they were deposited on the buds and shoots and on the sides of the lamp glasses.

Adelges **attacking Spruce and other Conifers.**—*Leafl. For. Comm.* no. 7 (revd.), 5 pp., 4 figs. London, 1946.

A leaflet on *Chermes* (*Adelges*) spp. in Britain [*R.A.E.*, A **9** 534] is revised to include the results of recent observations [*cf.* **24** 753 ; **32** 157 ; **35** 308].

The Black Pine Beetle (*Hylastes ater*) **and other closely allied Beetles.**—*Leafl. For. Comm.* no. 4 (revd.), 9 pp., 10 figs. London, 1946.

This revised version of a leaflet already noticed [*R.A.E.*, A **9** 544] has been expanded to include *Hylastes ater*, Payk., *H. cunicularius*, Er., *H. angustatus*, Hbst., *H. attenuatus*, Er., and *H.* (*Hylurgops*) *palliatus*, Gylh. Notes are given on the morphology of the adults, their breeding habits [*cf.* **6** 116], the various coniferous trees attacked (notably pine, except in the case of *H. cunicularius*, which prefers spruce), and the distribution of each species in Britain. Measures are described for the prevention of infestation by the first four species [*cf.* **32** 303–304 ; **35** 222] ; the last is not of sufficient economic importance to warrant control.

GAHAN (A. B.). **Eight new Species of Chalcid-flies of the Genus** *Pseudaphycus* **Clausen, with a Key to the Species.**—*Proc. U.S. nat. Mus.* **96** no. 3200 pp. 311–327. Washington, D. C., 1946.

A key to the species of *Pseudaphycus* is followed by a list of them, showing their distribution and their hosts when known. All are probably parasites of PSEUDOCOCCINAE and some are of considerable economic importance. The new species described include *P. meritorius* and *P. meracus*, reared from *Ferrisia* (*Pseudococcus*) *virgata*, Ckll., in Virginia, *Pseudaphycus abstrusus* and *P. alveolatifrons* from *Pseudococcus comstocki*, Kuw., in Virginia and New Jersey, respectively, *Pseudaphycus angustifrons*, from mealybugs, probably *Pseudococcus brevipes*, Ckll., intercepted in the United States on shipments of pineapple from Cuba, and *Pseudaphycus limatulus*, from a species of *Phenacoccus* found on *Andropogon* sp. in Maryland. *Pseudaphycus malinus*, sp. n., a parasite of

Pseudococcus comstocki in Japan and Korea, is the species that has been established in the eastern United States, where it is apparently giving very promising control of this mealybug [*cf. R.A.E.*, A **33** 79, 208–209, etc.]; it is described from material recovered in Virginia. *Pseudaphycus mundus*, sp. n., which is described from Louisiana material, has been reared from *Pseudococcus boninsis*, Kuw., in Louisiana and Georgia, from *Trionymus sacchari*, Ckll., in Porto Rico, and from *Phenacoccus gossypii*, Tns. & Ckll., *Pseudococcus comstocki* and *P. adonidum*, L., in laboratory breeding experiments, and has been taken in quarantine in Texas on cut flowers from Mexico. This species has become confused in the literature with *Pseudococcobius terryi*, Fullaway, which was introduced from Hawaii for the control of *Pseudococcus boninsis* on sugar-cane in 1932 and was supposedly established in Florida, Louisiana and Georgia [*cf.* **26** 137–138; **28** 240, etc.] and sent to Porto Rico [*cf.* **22** 137]. Examination of the material, however, shows that although the parasites received from Hawaii were *Pseudococcobius terryi*, those recovered from *Pseudococcus boninsis* in Louisiana and Georgia were *Pseudaphycus mundus*, and samples apparently constituting part of the original release in Georgia were also *P. mundus*. This species may be indigenous in Louisiana, since it was reared in New Orleans in 1916, and circumstantial evidence indicates that, in the attempt to increase the stock of the Hawaiian parasite in the laboratory, field-collected material of the host that had already been attacked by *P. mundus* was introduced into the cages, and that the two parasites thus became confused. *P. mundus* was reared from *T. sacchari* in Porto Rico during unsuccessful attempts to recover *Pseudococcobius terryi*, and it thus appears probable that it was introduced into Porto Rico and that the introduction was successful, although it was not the species intended.

Ghesquière (J.). **Contribution à l'étude des Microhyménoptères du Congo belge. X. Nouvelles dénominations pour quelques genres de Chalcidoidea et Mymaroidea.**—*Rev. Zool. Bot. afr.* **39** fasc. 4 pp. 367–371. Brussels, 1946.

The new generic names proposed include: *Psilogastrellus* for *Psilogaster*, Blanch. (Eucharid) nec R. L. (Lep.); *Lochitisca* for *Lochites*, Först. (Torymid) nec Gistl (Prot.); *Berecyntiscus* for *Berecyntus*, How. (Encyrtid) nec *Berecynthus*, Stål (Hem.); *Noblanchardia* for *Neocopidosoma*, Blanch. (Encyrtid) [*R.A.E.*, A **29** 344] nec Ishii (Encyrtid); *Pirenisca* for *Pirene* Hal. (Miscogasterid) nec Bolton (Moll.); *Mesopeltita* for *Mesopeltis*, Masi (Pteromalid) nec Cope (Rept.); *Stenomalina* for *Stenomalus*, Thoms. (Pteromalid) nec *Stenomalus* emend. for *Stenhomalus*, White (Col.); *Heteroscapiscus* for *Heteroscapus*, Brèth. (Eulophid) [**7** 125] nec Faust (Col.); *Hyssopiscus* for *Hyssopus*, Gir. (Eulophid) [**4** 259] nec *Isopus*, Montr. (Col.); and *Abbellisca* for *Abbella*, Gir. (Trichogrammatid) nec v. Heyd. (Arachn.).

Vayssière (P.). **Un *Cerococcus* nouveau nuisible au caféier au Congo belge.**—*Rev. Zool. Bot. afr.* **39** fasc. 4 pp. 376–380, 5 figs., 1 ref. Brussels, 1946.

Ghesquière (J.). **Biogéographie et pathogénie de *Cerococcus coffeae* Vayss. en Afrique tropicale (Hem. Coccidae).**—*T.c.* pp. 374–375, 7 refs.

Vayssière describes the female and neonate nymph of *Cerococcus coffeae*, sp. n., which was found by Ghesquière on coffee (*Coffea arabica*) in a district of the Belgian Congo north of Lake Kivu, and gives characters distinguishing the female from that of *C. hibisci*, Green.

Ghesquière describes the damage caused by *C. coffeae* in the Belgian Congo and records having found this Coccid on coffee in Kenya also. He considers that records of *C. hibisci* from coffee in Tanganyika [*cf. R.A.E.*, A **15** 326;

25 50] and Kenya [*cf.* **14** 552, 553] refer to *C. coffeae*. It infests the nodes at which the flower and leaf buds arise, causing the destruction of the latter, but soil analysis showed that symptoms such as chlorosis of the leaves and abnormalities of growth, which are often associated with its attack, are due primarily to a deficiency of available potassium oxide in the soil. These symptoms have been observed in plantations free from Coccids, and *C. coffeae* occurs occasionally in very small numbers on healthy plants.

RIVALS (P.). **Sur un parasite des filaos.**—*Rev. franç. Ent.* **13** fasc. 4 pp. 187–188. Paris, 1947.

Celosterna (*Coelosterna*) *scabrator*, F., which was first recorded in Réunion in 1919 [*R.A.E.*, A **8** 120], is common at altitudes of not more than 330 ft. in the sheltered part of the island and causes serious damage, particularly in dry years, to *Casuarina equisetifolia* in four artificial state forests. Other trees, such as *Pithecolobium dulce*, are occasionally attacked. The adults of this Lamiid, which are in flight in the hottest part of the day between October and March, feed on the young bark of the tips of the branches and on the main stems of trees 2–5 years old, often girdling them and causing the tips to shrivel and break off. The eggs are laid on the bark of the trunk or branches, and the larvae bore into the wood and make galleries, which sometimes extend to the roots. There is seldom more than one gallery per tree, and a single larva may consume all the wood in a young tree 3–6 ft. high. Control can be effected only by hand collection of the adults or by cutting infested trees down to ground level [*cf.* **20** 210]. Infested trees can be recognized by the small heaps of frass ejected by the larvae. *C. scabrator* does not occur in Mauritius, probably because of the higher rainfall there.

NOIROT (C.) & ALLIOT (H.). **La lutte contre les termites.**—96 pp., 37 figs., refs. Paris, Masson et Cie., 1947. Price *Fr.* 220.

In the first two sections of this book, C. Noirot gives a short, introductory account of the appearance, habits and classification of termites and their distribution in Africa (pp. 9–32) and describes the methods available for the control of infestations in timber, trees and agricultural crops (pp. 33–46). The third section (pp. 47–82) is by H. Alliot and comprises three chapters. In the first, details are given of methods of constructing buildings to render them termite-proof. The second is concerned with resistant woods and consists almost entirely of lists of species that are reputed to be resistant, probably resistant and susceptible to termite attack, showing the scientific and popular names, distribution and uses or characteristics of each. The third contains information on materials used for impregnating timber to protect it from attack, the best pressure methods (the Bethell and the single and double Rüping methods) and an immersion method for doing this, and suitable woods for impregnation. The results of tests of the extent to which various timbers from the French colonies absorbed certain preservatives with which they were impregnated by the Bethell method are shown in tables. Specifications for creosote for impregnation and injection are given in two appendices.

SNYDER (T. E.). **Our Enemy the Termite.**—Revd. edn., 9½×6 ins., xiii+257 pp., frontis., 84 figs. Ithaca, N.Y., Comstock Publ. Co., Inc.; London, Constable & Co., Ltd., 1948. Price 20*s*.

This second edition of a handbook on termites and their control in the United States resembles the first [*R.A.E.*, A **24** 295] in scope and arrangement, but the text has been revised, and the information, notably that on control, brought

up to date. There are two additional appendices, of which one contains the fundamental principles for the control of subterranean termites in buildings advocated by the National Pest Control Association, and the other comprises three keys, based respectively on winged adults, soldiers, and habits and prominent characters, to the genera and subgenera of termites represented in the United States.

PICKLES (A.). **Estimation of the Number of Froghopper Eggs in Cane-field Soil.**—*Proc. agric. Soc. Trin. Tob.* **46** pt. 1 pp. 75, 77, 79, 81, 83, 7 refs. Port-of-Spain, 1946.

Observations in Trinidad have shown that the sugar-cane froghopper [*Tomaspis saccharina*, Dist.] passes the dry season in the egg stage [*R.A.E.*, A **19** 457] and that almost all the eggs are laid in the soil close to the cane-stalks [**20** 94; **21** 647].

The tillage applied to sugar-cane fields before they are replanted makes it practically impossible for the froghoppers to survive in them in sufficient numbers to cause injury of importance, and, although it is not economically sound to grow only plant canes, tillage and replanting of infested cane-fields may be used to some extent as a direct means of control. During the dry season, when major tillage operations are practicable, there is little to indicate the chances that a particular field will be severely attacked in the ensuing wet season, since nymphs and adults are absent and the fact that the field has recently been damaged does not necessarily indicate that large numbers of eggs have been laid in it. A survey made in 1931 showed that the concentration of eggs in the soil was lower in fields that had been severely damaged during the wet season of 1930 than in fields that had not. The fields were left uncultivated, and the emergence of froghoppers followed the distribution of eggs indicated by the survey remarkably closely, only those fields indicated as dangerous by the survey being damaged by the initial outbreak. Subsequent experience, during which technical methods were greatly improved, confirmed the accuracy of a survey of this nature. Planned tillage according to an egg survey has limitations as a practical method of control, firstly because the survey indicates the fields most likely to be seriously infested and not the probable severity of the infestation, so that there is a chance that even fields containing many eggs may not be seriously damaged, and secondly, because replanting generally follows a long-term programme based on the orderly replacement of old ratoons, and rigid application of the results of an egg survey would tend to expand the annual ploughing programme to an unreasonable degree. Moreover, the technique of an egg survey is difficult. However, the method is likely to be of value, when old ratoons near large blocks of promising plant or first ratoon canes might seriously endanger them, and it is also possible in many cases to arrange the replanting programme to include fields containing a large population of froghopper eggs.

Sampling must be done with care. A single sample consisting of fifty disks of soil one inch deep and 2¾ inches in diameter removed from the vicinity of separate stools chosen at random along a line across the field is put in water for 12–24 hours and then washed through a series of sieves. The material retained by the last sieve (70-mesh) is allowed to dry, and then five fractions, each 2 cc. in volume, are spread out on black paper and examined for eggs. The results are compared with those obtained from a sample of disks taken from the opposite side of the same plants; an appreciable difference in the volumes of the washed samples indicates a sampling error, whereas a great disparity in the number of eggs shows that the number of disks taken is insufficient to be representative. Experience has shown, however, that such errors very seldom occur when the technique is carefully followed. It is difficult to establish a definite

line between dangerous and harmless populations, but there is no doubt that fields with 750 or more eggs per sample are extremely likely to develop serious outbreaks and that the prospects in fields with 500–750 per sample are somewhat doubtful.

PICKLES (A.). **Entomology.**—*Adm. Rep. Dir. Agric. Trin. Tob. 1945* pp. 17–18. Trinidad, B.W.I., 1946.

Injury to sugar-cane by the froghopper [*Tomaspis saccharina*, Dist.] was not very severe in Trinidad in 1945 but was fairly widespread in northern areas. The results of field experiments on its control by dusting with DDT and sabadilla [*R.A.E.*, A **35** 141] are summarised. Detailed observations on the influence of biotic factors on its abundance were begun, and the preliminary data indicated that the green muscardine fungus [*Metarrhizium anisopliae*] can give significant control and that its incidence is related to atmospheric humidity [*cf.* **21** 520]. Observations on infestation of cucumbers by *Diaphania hyalinata*, L., and *D. nitidalis*, Stoll, showed that recumbent (non-staked) plants gave a significantly higher yield of healthy fruit than climbing (staked) plants ; 5 per cent. cubé powder applied weekly gave better control than a lead arsenate dust. Weekly applications of dusts of lead arsenate or cubé against *Hellula phidilealis*, Wlk., on cabbage and cauliflower, gave significant increases in yield, the cubé being the more effective on the cauliflowers, and the lead arsenate on the cabbages. The use of cubé was recommended, because it is not poisonous.

To assess the value of inert dusts for protecting stored grain from insects, grain heavily infested with weevils and *Plodia interpunctella*, Hb., was mixed with 1 per cent. micronised felspar or a proprietary dust (Fygran A) and stored in bags. The percentages of uninjured grains at the end of eight months were 37·24 for felspar, 34·45 for Fygran A, and 11·69 for no treatment.

Other insect pests observed included *Megastes grandalis*, Gn., on sweet potatoes ; *Ascia* (*Pieris*) *monuste*, L., *Plutella maculipennis*, Curt., and *Brevicoryne brassicae*, L., on crucifers ; *Corythaica monacha*, Stål, *Epitrix* sp. and *Saissetia oleae*, Bern., on egg-plant [*Solanum melongena*] ; and *Chrysomphalus ficus*, Ashm., *Orthezia praelonga*, Dougl., *Lepidosaphes gloveri*, Pack., *L. beckii*, Newm., and *Selenaspidus articulatus*, Morg., on *Citrus*.

DAVIAULT (L.). **Septième rapport annuel sur l'entomologie forestière pour l'année finissant le 31 mars 1944.**—*Rapp. Minist. Terres For. Québec 1943–44* repr. 9 pp., 2 graphs. Quebec, 1945.

R. Lambert (pp. 3–4) reports that *Harmologa* (*Archips*) *fumiferana*, Clem. [on *Abies balsamea* and spruce] was the most important forest pest in Quebec in 1943 [*cf. R.A.E.*, A **34** 173]. It has spread each year since it reappeared in the West of the Province in 1939, particularly towards the east, and although it has caused little damage so far, may become a serious danger. *Gilpinia hercyniae*, Htg., continued to decline in numbers on spruce, chiefly owing to the virus disease that attacks the larvae [*cf.* **33** 398], and no important foci of infestation remained. Maples in some places south of the St. Lawrence River were again severely defoliated by larvae of *Paleacrita vernata*, Peck, and *Erannis tiliaria*, Harr., but laboratory investigations showed that parasitism had increased and that the larvae were being attacked by disease, and it was considered unlikely that defoliation would be so severe in 1944. Die-back of birch south of the St. Lawrence, which has been observed in many localities for some years, does not appear to be caused by *Agrilus anxius*, Gory, which could not be found in many of the injured trees [*cf.* **34** 130].

In a note on the establishment of parasites of *G. hercyniae* (pp. 4–5), G. Paquet records that in two localities in a district in which large numbers of

Dahlbominus (*Microplectron*) *fuscipennis*, Zett., were liberated in 1940 and 1941, and several colonies of species of *Exenterus* and *Sturmia* in 1942, ten of 2,822 larvae of *G. hercyniae* collected were parasitised by *Exenterus* and eight by *Sturmia*, and 15, six and one of 585 cocoons by *Exenterus*, *D. fuscipennis* and *Mesoleius tenthredinis*, Morl., respectively. Of 790 cocoons collected between the two localities, 69 were parasitised by *D. fuscipennis* and one by *Exenterus* or *Sturmia*.

R. Martineau (pp. 6–9) gives an account of investigations on wood- and bark-eating insects in the trimmings from felled trees and in areas on which the trees had been burnt, carried out to determine the effect of various methods of disposal of forest débris on insect activity and to follow the development of wood borers, particularly *Monochamus scutellatus*, Say, in various stands damaged by fire. The investigations on cut wood were not complete, but those on burnt areas indicated that *M. scutellatus* is the important insect attacking spruce and jack pine [*Pinus banksiana*] damaged by fire. The eggs are deposited in the bark, and the larvae bore through the bark into the wood. The life-cycle appears to last two years, with occasional exceptions in which it is completed in one. The trees are usually attacked at all heights, but chiefly in the lower parts, and spruce is more heavily attacked than pine. The larvae travel more rapidly through *P. banksiana* than through black spruce [*Picea mariana*], and larval mortality increases after the wood has been reached. The number of galleries per sq. ft. of bark at different tree heights and diameters, for trees containing more than 75 galleries, are shown on graphs.

DAVIAULT (L.). **Forest Entomology. Eighth annual Report for the Year ending March the 31st, 1945.**—*Rep. Dep. Lds For. Quebec 1944–45* repr. 12 pp. Quebec, 1946. (Also in French, 12 pp.)

This report includes notes on the bionomics of the spruce budworm [*Harmologa fumiferana*, Clem.], on die-back of birch and on insect vectors of Dutch elm disease (*Ceratostomella ulmi*) in Quebec in 1944–45 (pp. 3–5) by J. P. Picard. Practically equal numbers of males and females of *H. fumiferana* were reared in the laboratory; they lived for averages of 4·5 and 9·5 days, respectively. The females laid an average of 65 eggs each, whereas in cages in the field, the average was 52. The principal species of parasites obtained were *Apechthis* (*Ephialtes*) *ontario*, Cress., *Itoplectis conquisitor*, Say, *Glypta fumiferanae*, Vier., *Zenillia* (*Aplomya*) *caesar*, Aldr., *Aphaereta muscae*, Ashm., and *Amblymerus verditer*, Nort. Examination of white and yellow birches [*Betula papyrifera* and *B. lutea*], which have been dying in large numbers in widely diverse localities for a number of years, again gave no definite indication of the cause, the bronzed birch borer [*Agrilus anxius*, Gory] being present in some but not in others [*cf.* preceding abstract]. It is considered that mortality will continue, particularly in the most heavily attacked stands, and rapid cutting of all trees in these stands, before they become a total loss owing to infestation by Scolytids or fungi, is advisable. *Hylastes* (*Hylurgopinus*) *rufipes*, Eichh., *Magdalis barbita*, Say, *M. armicollis*, Say, and *Eutetrapha* (*Saperda*) *tridentata*, Ol., of which only the first is known as a vector of *C. ulmi* in the United States, were bred from branches of diseased elms [*cf.* **36** 163]. *Scolytus multistriatus*, Marsh., the principal vector in the United States, has not been found in Quebec.

In a note on the survey of the forest insects of Quebec and accounts of investigations on the European spruce sawfly [*Gilpinia hercyniae*, Htg.] and on Lepidoptera injurious to spruce (pp. 6–10), R. Lambert reports that infestation by *H. fumiferana* had considerably increased in intensity in all districts already attacked and spread to new ones, and that a further decrease in infestation by *G. hercyniae* was caused by its virus disease. About 400,000 examples of *Dahlbominus* (*Microplectron*) *fuscipennis*, Zett., 605 of *Exenterus*

amictorius, Panz., and 207 of *Sturmia* sp. were released against *G. hercyniae* during the summer of 1944. Large numbers of first-generation cocoons of the sawfly were obtained from three localities in 1941–43 to ascertain whether they would give rise to adults in the same summer. None of those from the north shore [of the Gaspé] did so, but adults emerged from 2·6 and 7–16·9 per cent. of those from different places in the Laurentide Park in 1942 and 1943, and from 31 per cent. of those from Berthierville, much further south, in 1942 [*cf.* **30** 448–449]. The tendency to diapause was apparently related to the date of spinning the cocoon ; in 1942 all larvae that spun cocoons after 23rd June at Berthierville remained in diapause until the following spring. In that year adults of the overwintered generation were present at Berthierville from 15th May to 9th July and those of the first generation from 23rd July to 14th August ; in 1943 and 1944, the spring adults were present from 23rd May until 7th and 17th July, respectively, but the summer adults were not observed. The average lengths of life of the adults in outdoor cages were 5·1 and 3·5 days for the overwintered and first generations in 1942 and 10·1 days for the overwintered generation in 1943 and 1944. In 1943 and (in brackets) 1944, the oviposition period lasted 2–11 (1–5) days and females deposited 7–35 (5–15) eggs, of which 90·7 (95·2) per cent. hatched, in 9–13 (8–10) days.

Investigations on Lepidopterous larvae that attack spruce in nurseries or ornamental plantings showed that the principal species, in order of decreasing importance, were *Recurvaria* sp., *Tortrix packardiana*, Fern., *Dioryctria reniculella*, Grote, *Taniva albolineana*, Kearfott, *Harmologa fumiferana*, *Zeiraphera ratzeburgiana*, Ratz., *Herculia intermedialis*, Wlk., *Camptylochila* (*Epizeuxis*) *aemula*, Hb., and *Tortrix* (*Archips*) *striana*, Fern. Many parasites were bred from these insects, and lists of the principal ones are given. Those specifically identified include *Macrocentrus peroneae*, Mues., *Itoplectis conquisitor*, *Eupelmella vesicularis*, Retz., *Meteorus trachynotus*, Vier., *Phytodietus annulatus*, Prov., *Bracon* (*Microbracon*) *politiventris*, Cush., *Actia interrupta*, Curran, *Nemorilla pyste*, Wlk., *Amblymerus verditer*, *Habrocytus phycidis*, Ashm., and *Dibrachys cavus*, Wlk., from *Tortrix packardiana* ; *D. cavus*, and *A. verditer*, from *Taniva albolineana* ; *I. conquisitor*, *D. cavus*, *A. verditer*, and *Pimpla inflata*, Townes, from *Camptylochila aemula* ; *Lissonota parva*, Cress., *Apanteles fumiferanae*, Vier., *H. phycidis* and *Plectops currei*, Tns., from *Dioryctria reniculella* ; *Bracon* (*Microbracon*) *gelechiae*, Ashm., from *Recurvaria* ; and *Nemorilla floralis* var. *maculosa*, Mg., *Actia interrupta*, *Apanteles fumiferanae*, *Agathis* (*Bassus*) *bicolor*, Prov., *I. conquisitor*, *Glypta fumiferanae* and *Amblymerus verditer* from *Harmologa fumiferana*.

RICE (P. L.). & MACCREARY (D.). **Peachtree Borer Control in Delaware.**—*Bull. Del. agric. Exp. Sta.* no. 261, 21 pp., 3 figs., 8 refs. Newark, Del., 1946.

The following is almost entirely based on the authors' summary. Three consecutive years' experiments to compare the value of ethylene-dichloride emulsion, paradichlorbenzene (as crystals) and Parascalecide (a proprietary preparation comprising paradichlorbenzene dissolved in miscible oil) for the control of *Aegeria* (*Sanninoidea*) *exitiosa*, Say, in Delaware were carried out in seven orchards containing peach trees of three commonly grown commercial varieties that were all three years old in 1941 when the study began. Ethylene-dichloride emulsion (½ U.S. pint per tree) was applied at the recommended concentrations of 15 per cent. to three-year-old trees and 20 per cent. to older ones, and also, in one orchard, at increased concentrations of 20 per cent. for three-year-old trees and 25 per cent. for older ones. Paradichlorbenzene and Parascalecide (diluted 1 : 7) were applied at the recommended rates of ½ oz. and 1 U.S. pint, respectively, to three-year-old trees and ¾ oz. and 1½ U.S. pints to older ones.

None of the insecticides retarded the growth of the trees, and no serious injury resulting from the use of any of them was observed even in an orchard situated on heavy loam, which was very wet when the ethylene-dichloride emulsion (at both concentrations) and paradichlorbenzene were applied in 1942 [*cf. R.A.E.*, A **30** 529]. All treatments gave commercial control, the average per cent. control (computed by Abbott's formulae [**13** 331]) being 88·3 for paradichlorbenzene, 94·1 for Parascalecide and 97·1 and 97·8 for ethylene dichloride at the recommended and increased concentrations. The experiments supported the conclusions of others that ethylene dichloride can be effectively applied at lower temperatures than Parascalecide, and the latter at lower temperatures than paradichlorbenzene crystals, for which a soil temperature of at least 60°F. is necessary.

CHANDLER (S. C.). **Codling Moth Control : a Study of Growers' Practices.**—*Bull. Ill. agric. Exp. Sta.* no. 519 pp. [1+]295–330[+2], ill., 2 refs. Urbana, Ill., 1946.

The results are given of a survey carried out in the southern apple-growing section of Illinois, where there are three generations of *Cydia* (*Carpocapsa*) *pomonella*, L., in the year and its control requires a specially heavy outlay of time and money, to determine why some growers generally secure control, whereas others in the same neighbourhood do not. Thirteen orchards were investigated, and everything done in them that might have a bearing on control was noted. Only mature trees were included in the study, and the orchards were visited once a week during the growing season. Records were kept of the spray schedules used and of the percentages of fruit injured at the end of the first-generation period and just before harvest. The percentages of apples infested and superficially injured just before harvest at the top and bottom of the trees of each variety in each of the orchards and the averages for each orchard, in 1942, 1943 and 1944, are shown in tables. Some of the orchards had a uniformly low infestation for all three seasons, some a uniformly high one and others varied considerably from year to year or from block to block. Some varieties were more heavily infested than others, but the range in the percentage of infested apples between the two groups was smaller in orchards having a low infestation than in those having a high one, and it was found that varietal differences were of little importance provided that the infestation was kept at a low level.

The number of larvae that survived the winter had a definite influence on summer infestation, but high populations in spring were partly overcome by unfavourable weather and suitable spray schedules. Good orchard sanitation, including pruning, burning brushwood, clearing away débris, scraping, banding, screening sheds and keeping crates free from infestation, appeared to be at least as important as good spraying and should be regularly practised. Neither initiative on the part of the owner in studying better methods of control nor his participation in the work assured good results. The quantity and quality of spraying equipment was important, and thorough spraying was essential. Growers' results failed to prove conclusively that the use of a tower increased the deposit on the tops of the trees, but it was almost essential for large trees when a non-stop spraying system was used. The non-stop system of spraying was particularly useful when there was a big area to cover, as it took less time than stopping at each tree, but a pump supplying 35 U.S. gals. per minute from a tank holding 500 U.S. gals. was needed, and it had to be moved slowly enough to ensure thorough spraying of each tree. A Speedsprayer was used in one orchard in 1944. It saved time, labour and material, but did not prevent the infestation from being higher than in 1943, and the percentage of infested apples was very high in the tops of the trees [*cf. R.A.E.*, A **35** 81, etc.]. Top-off

sprays helped to equalise the coverage in the tops and the lower branches of the trees and were just as necessary when the Speedsprayer was used as with other methods.

Schedules of lead arsenate throughout the season and of lead arsenate early and nicotine sulphate or fixed nicotine late in the season both gave good control in some orchards and poor control in others, and good results can apparently be secured from any of the commonly used spray schedules. Growers who paid no attention to the timing of sprays got poor results, whereas those who waited to spray until the first eggs were ready to hatch got excellent control. Timing towards the end of the season proved very important in 1943 and 1944, when hatching continued later than usual, except in two orchards in which low survival through the winter, good orchard sanitation and thorough control of the first generation had reduced infestation so much that no sprays were required after the first week in July. A good deposit of poison on the fruit was shown to be necessary, and this was obtained by thorough application of adequate quantities of sprays of high concentration and by pruning to open up the trees. Large numbers of applications were not required, though it was necessary to apply sprays frequently enough to ensure protection of the fruit throughout the period of attack, and closely spaced sprays were particularly necessary where nicotine was used. Although it is difficult to prove that a deposit of spray can be built up by means of summer oils and adhesives, there were several instances in which heavy dosages of summer oils seemed to improve control, and one grower achieved good results by applying eight or nine sprays of lead arsenate, with soy-bean flour instead of summer oil as a spreader and adhesive, in May and June and none after that time. The lead tolerance was not exceeded, but it is probable that this method would have failed if the overwintering population had not previously been reduced as a result of careful and thorough spraying, orchard sanitation and proper pruning. It is considered possible that the poor control in one orchard in which heavy applications of lead arsenate had been made for several years was due to the development of a resistant strain of *C. pomonella*.

Notes on the results of tests with DDT in 1945 and 1946 are appended. Its superiority as an insecticide did not compensate for poor spraying or poor orchard sanitation ; thus, in one orchard in which the tops of the trees were insufficiently sprayed, the percentage infestation reached 14·3 in the tops as compared with only 0·3 in the bottoms, and in another, as many as ten sprays insufficiently applied to a light crop gave only fair control. DDT caused some plant injury when combined with oil and killed the natural enemies of mites and some other pests. A serious outbreak of the red-banded leafroller [*Eulia velutinana*, Wlk.] following its use occurred in many orchards in 1946, and up to 20 per cent. of the apples were damaged by it, so that it became even more injurious than *Cydia*. The severity of the infestation appeared to increase with the amount of DDT applied, so that it is desirable to use as little against *Cydia* as possible. DDT is apparently less effective than lead arsenate against *Eulia* and also kills its natural enemies. Furthermore, it is difficult to remove from the gathered fruits and creates a residue problem.

Goodall (F. L.), Gorton (T. F.) & Summersgill (J. V.). **DDT and its Textile Applications.**—*J. Soc. Dy. Col.* **62** pp. 189–198, 2 graphs, 20 refs. Bradford, 1946.

The authors describe the preparation and properties of DDT and its characteristics as an insecticide, and give a detailed account of methods of applying it commercially to textiles, to protect them from insect attack or to prevent them from harbouring undesirable insects, and of estimating the quantity present in treated material. They also discuss its chemical stability,

resistance to the processes that textiles may undergo and toxicity to man, and the proprietary forms in which it is available for textile treatment.

Lists are given of insects that attack keratin (various clothes moths and Dermestids) or cotton and cellulose fibres (*Lepisma saccharina*, L., *Thermobia domestica*, Pack., and termites) in textiles, and of injurious insects that may shelter in them. In addition to lice, fleas and household pests, the latter include such insects as *Calandra* and *Tribolium*, since experiments indicate that these could be controlled by the treatment of sacks in which grain or flour is stored. The concentration required for effective moth-proofing is 0·1 per cent. DDT, and 0·05 per cent. has a marked effect. DDT can be applied from solvents, from aqueous suspensions or as a dust in an inert carrier; it was found that fabrics containing 1–1·5 per cent. DDT applied from solvents generally lose about 40–60 per cent. of the DDT in one wash, depending to some extent on the nature of the washing treatment, whereas if the DDT is applied from an emulsified solution the loss may be slightly greater, possibly because emulsifying agents present on the fabric may tend to re-emulsify the DDT slightly on immersion in water. The removal of the DDT appears to depend more on the detergent power of the solution than on temperature and pH value. If a fabric containing 1–2 per cent. DDT is washed several times, some DDT is removed each time, but when the DDT content is reduced to about 0·1–0·2 per cent., the residue seems to be more resistant to washing. In general, DDT would be removed almost entirely by the solvents used in dry cleaning.

DEAN (R. W.). **Apple Maggot Control with DDT Sprays and Dusts.**—*J. econ. Ent.* **40** no. 2 pp. 183–189, 6 graphs, 4 refs. Menasha, Wis., 1947.

This account of investigations on the use of DDT to control the apple maggot [*Rhagoletis pomonella*, Walsh] on apple trees in New York includes details of work carried out in 1944 and 1945, which has already been noticed [*R.A.E.*, A **36** 59], and an account of further tests of commercial preparations in 1946. All the trees in more or less isolated blocks or orchards were treated, and the efficiency of the treatment was estimated by comparison with the infestation in the preceding year. Sprays of 2 lb. Gesarol AK50 (50 per cent. DDT) with 8 lb. wettable sulphur paste or 4 lb. dry wettable sulphur per 100 U.S. gals. spray, applied on 24th June and 3rd and 16th July reduced the percentage of infested fruit to 0·84, as compared with 32·15 in 1945. Sprays of 2 lb. Deenate 50W (50 per cent. DDT) with 5 lb. wettable sulphur per 100 U.S. gals. applied on the same three dates in two neighbouring orchards and again on 25th July in one of them reduced it to 36·3 and 12·53 as compared with 95 in 1945. These two orchards were almost surrounded by unsprayed woodlands from which many flies migrated to them late in the season. A dust of Deenate 50P (50 per cent. DDT) in talc (1 : 9) applied on 24th June and 2nd, 10th and 18th July and on these dates and 26th July reduced infestation to 2·86 and 0·62 per cent., respectively, as compared with 40 and 25 per cent. in 1945.

It is concluded that the residue from DDT sprays and dusts kills adults of *R. pomonella* rapidly, but affords protection over a shorter period than does lead arsenate under field conditions. The period of effectiveness appears to be about two weeks for sprays applied at the rate of 1 lb. actual DDT per 100 U.S. gals. and three DDT sprays are needed where two lead-arsenate sprays would be used. To ensure maximum speed of kill, thorough coverage of all trees within the orchard and all bordering woodlands and hedgerows is necessary. Where migration of flies from neighbouring unsprayed trees occurs, DDT should be applied later in the season than is customary when a lead-arsenate programme is followed. Examination of spray residues at harvest indicated that under present spray-residue tolerances, DDT may be used for the control of *R. pomonella* on early varieties of apple with greater safety than lead arsenate.

Ditman (L. P.), Smith (F. F.) & Burkhardt (G.). **Liquefied Gas Aerosols for Pea Aphid Control : Third Report.**—*J. econ. Ent.* **40** no. 2 pp. 190–194, 4 figs., 2 refs. Menasha, Wis., 1947.

Further investigations on the use of liquefied-gas aerosols for the control of the pea Aphid [*Macrosiphum onobrychis*, Boy.] on peas in Maryland [*cf. R.A.E.*, A **35** 255, etc.], were carried out under commercial conditions. A solution of DDT, Velsicol AR-60, cyclohexanone, acetone and Freon-12 [dichlordifluoromethane] (5 : 5 : 5 : 35 : 50) was used in most treatments, and one containing methyl chloride instead of Freon-12 was used to compare the effectiveness of these two propellent gases in a few tests.

The liquefied-gas solutions were prepared in the canning plant by a method described, which was found to be both quick and simple. The aerosols were applied from two dispensers, with 24- and 30-foot booms carrying pairs of nozzles 3 feet apart, mounted on trucks carrying four cylinders of solution, which was sufficient to treat 40 acres of peas. At atmospheric temperatures of about 70°F., approximately 10 lb. per acre was applied when the trucks were driven at 5 miles per hour, but during the period of treatment (2nd–11th May), lower temperatures sometimes resulted in rates as low as 7 lb. per acre. The work was carried out successfully and rapidly, and the machines were found to work efficiently. The light equipment was satisfactory in wet fields, and treatment was effective when wind velocity prevented the application of dusts. At the time of treatment, Aphid populations varied from 31 to over 300 per sweep of the insect net. Populations of not more than 100 per sweep caused no visible injury to the plants, but populations approaching 200 or more before treatment caused visible injury from which the plants never completely recovered, even though the numbers were reduced by over 90 per cent. in many cases, as compared with controls. Examination at harvest showed increases in green weight of vines and shelled peas, though treated peas were generally less mature than untreated ones. Aerosols containing Freon-12 were slightly inferior to those containing methyl chloride and to a DDT emulsion-spray when both were applied to give 0·5 lb. actual DDT per acre, and they are more expensive than emulsions or dusts containing DDT.

Cox (J. A.). **Control of the Grape Leafhopper.**—*J. econ. Ent.* **40** no. 2 pp. 195–198, 1 fig., 2 refs. Menasha, Wis., 1947.

An account is given of further tests in 1945 and 1946 on the control of *Erythroneura comes*, Say, on grape vines in Pennsylvania [*cf. R.A.E.*, A **34** 247]. The sprays were applied to the Concord variety at the rate of 175–200 U.S. gals. per acre with a power sprayer and a covered, inverted U-shaped boom carrying five nozzles on each side of the row. The materials tested comprised nicotine sulphate, a miscible oil containing 20 per cent. DDT (Gesarol Emulsion), six wettable powders containing, respectively, 40, 50 and 25 per cent. DDT (Gesarol A K40, Gesarol AK50 and Deenate 25W), 50 per cent. dichlordiphenyldichlorethane (Rhothane WP50), 13·5 per cent. β, β-dithiocyanodiethyl ether (Lethane B-72) and 48 per cent. sabadilla seed (Sabacide), and a water-dispersible powder containing 50 per cent. benzene hexachloride and 5 per cent. of the γ isomer. All were applied in Bordeaux mixture and all but Gesarol Emulsion with a small amount of oil; lead arsenate was sometimes included with nicotine sulphate. All spray quantities are given per 100 U.S. gals.

In 1945, one application in mid-June, before flowering time, of sprays containing 2 U.S. quarts Gesarol Emulsion or 1½ lb. Gesarol AK40 gave very satisfactory control throughout the season and was as effective as one post-blossom spray or as two applications. One pre-blossom application of a spray containing 1½ lb. Rhothane WP50 was equally effective. Both 12 oz. nicotine

sulphate and 2 lb. Lethane B-72 greatly reduced populations, but permitted them to increase later, so that there was considerable foliage injury by early September. In tests in large vineyards, applications of DDT (2 lb. Gesarol AK40 or 3 lb. Deenate 25W) on 5th July, 6th and 19th July, 7th and 22nd July or 8th and 21st July gave complete control of leafhoppers for the rest of the season, whereas applications of 12 oz. nicotine sulphate on the same dates did not give sufficient protection, so that there was considerable foliage injury in late summer.

In 1946, one application of 1 lb. Gesarol AK50 in June before blossom time gave excellent control throughout the season, whereas 2 lb. benzene-hexachloride powder, applied at the same time, did not appreciably reduce leafhopper populations. In post-blossom sprays, ½ and 1 lb. Gesarol AK50 and 1 lb. Rhothane WP50 gave better control than 1 U.S. pint nicotine sulphate or 2 lb. benzene-hexachloride powder, and 4 oz. actual DDT was as effective as 8 oz. Sprays of benzene hexachloride at the same strength as before did not give satisfactory control of a light infestation of leafhoppers when applied on 28th June and 19th and 23rd July, whereas sprays of 6 lb. Sabacide applied on the same dates reduced the number per ten leaves from 210 to 12 ; this material requires further testing.

Since DDT sprays controlled the leafhopper for a long time, investigations were made to determine whether the plant absorbed some of the spray. Nymphs were caged on the underside of leaves that had previously been sprayed with 1 lb. DDT per 100 U.S. gals. only on the top. The tests were repeated several times, and the results indicated that the nymphs fed on the treated leaves and completed development as readily as others that fed on unsprayed leaves. No damage to the fruit or foliage of Concord grape was observed where DDT sprays were used.

Anderson (L. D.) & Brooks (J. W.). **Pea Aphid Control in eastern Virginia.**—*J. econ. Ent.* **40** no. 2 pp. 199–205, 1 fig., 4 refs. Menasha, Wis., 1947.

The authors describe experiments with DDT, BHC (benzene hexachloride), cubé (containing 5 per cent. rotenone) and other insecticides and various methods of applying them for the control of *Macrosiphum onobrychis*, Boy. (*pisi*, Kalt.) on peas, carried out in Virginia in 1946, when populations became large enough to warrant treatment by the last week of April and remained large until the middle of May, by which time they had caused heavy damage to untreated plants.

In tests at Machipongo, where treatments were made between 10 a.m. and 5.30 p.m. on 30th April, before the plants flowered, 1 per cent. mixed and impregnated DDT dusts, 5 per cent. DDT in liquefied-gas aerosols, 10 per cent. cubé dusts, BHC dusts (0·225–0·6 per cent. γ isomer) and dusts containing 3 per cent. nicotine with 0·75 per cent. γ BHC or 2 per cent. oil all caused significant reductions in Aphid populations, as compared with no treatment. Impregnated DDT dusts made with a non-volatile solvent gave significantly better results after one and three days than mixed DDT dusts without oil, but were not significantly better than a mixed DDT dust to which a non-volatile solvent had been added. DDT impregnated dust in which a volatile solvent was used was no better than the regular mixed DDT dust, and 3 per cent. DDT seemed to be no more effective than 1 per cent. in an impregnated dust. The 1 per cent. DDT impregnated dust with a non-volatile solvent, prepared by dissolving 1 lb. DDT in 3 lb. Velsicol AR-60 and spraying it on 99 lb. pyrophyllite while mixing, seemed the most practical and efficient of the DDT dusts. The aerosol was usually inferior to the better impregnated dusts when applied at 10 lb. per acre and not much better at 20 lb. per acre. There appeared to be no significant differences between 20 and 10 per cent. cubé dusts or between those

with and without 2 per cent. oil or 1 per cent. Lethane B-71 [14 per cent. β,β′-dithiocyanodiethyl ether]. BHC dusts containing 0·6 and 0·9 per cent. γ isomer appeared to give excellent control in all cases, but one containing 0·225 per cent. appeared somewhat less effective. The addition of 3 per cent. nicotine did not significantly increase the effectiveness of BHC, and the other nicotine dust had such poor dusting qualities that it could not be applied at a comparable rate. Analysis of the most uniform records for them indicated that cubé was significantly less effective and BHC almost significantly more effective than DDT.

At Onley, dusts and sprays were applied between 1 and 5 p.m. on 2nd May, when the plants were beginning to bloom, and all resulted in highly significant reductions in Aphid population and increases in yield. They comprised mixed and impregnated dusts containing 1 per cent. DDT, sprays of 2 lb. wettable powder (50 per cent. DDT), 2·5 U.S. gals. emulsion concentrate containing 2·5 per cent. DDT, or 0·25 U.S. gals. emulsion concentrate containing 25 per cent. DDT per 100 U.S. gals. water, an atomised spray of oil containing 2·5 per cent. DDT, a spray of 6 lb. cubé and 1 U.S. quart Red A soap per 100 U.S. gals., and dusts containing 20 per cent. cubé, 0·9 per cent. γ BHC or 0·75 per cent. γ BHC with 3 per cent. nicotine. The results obtained with the 1 per cent. DDT regular mixed dust and the 1 per cent. DDT impregnated dust made with a volatile solvent were not significantly different, but both were significantly less effective than the 1 per cent. DDT impregnated dust made with a non-volatile solvent and the 1 per cent. DDT regular mixed dust, to which the non-volatile solvent had been added. The wettable-powder spray also gave comparatively poor results, but the emulsions were very effective. The 2·5 per cent. emulsion concentrate gave slightly better Aphid control but significantly lower yield than the 25 per cent. concentrate, probably owing to stunting of the plants caused by the excessive amount of oil. The atomised oil treatment gave significantly less control than either emulsion concentrate and significantly lower yields than the 25 per cent. concentrate. The cubé spray gave almost as good control as the best DDT sprays and dusts, but the cubé dust was significantly less effective, and both spray and dust gave significantly lower yields than the best DDT sprays or dusts. BHC with nicotine was about equal in effectiveness to the cubé dust, and BHC alone was significantly better than all other treatments in Aphid control and yield. It gave a 99 per cent. reduction in Aphid population and a yield of 1,519 lb. shelled peas per acre, as compared with 188 lb. for no treatment. No objectionable odour was detected in peas from the plots treated with BHC that were canned at the time of harvest. Aerosols containing 5 per cent. DDT in Freon-12 [dichlordifluoromethane] and methyl chloride were also tested, but on too small a scale for statistical analysis of the results ; they gave 91 and 99 per cent. Aphid control and yields of 1,089 and 1,573 lb. shelled peas per acre, respectively, when applied at 20 lb. per acre and 85 and 85 per cent. control and 920 and 1,186 lbs. peas per acre when applied at 10 lb. per acre. Analysis of samples of plants showed no DDT residue on plants treated with the 1 per cent. DDT impregnated dust or the methyl-chloride aerosol. Plants treated with the Freon-12 aerosol at 20 and 10 lb. per acre had 8·6 and 3 parts DDT per million parts dry plant weight, respectively, and those that received DDT as the wettable powder, the 25 per cent. emulsion concentrate and the atomised spray had 0·4–0·8 p.p.m.

In tests with dusts applied from an aeroplane at 50 lb. per acre on 9th May, an impregnated dust containing 1 per cent. DDT and 2 per cent. Lethane A-70 [90 per cent. β,β′-dithiocyanodiethyl ether] gave 85–87 per cent. control when applied before the dew was off the plants and when the wind velocity was almost zero, a BHC dust (0·6 per cent. γ isomer) applied at the same time gave 99 per cent. control, and an impregnated dust containing 1 per cent. DDT, applied after the dew had left the plants and when the wind velocity

was about 5 miles per hour, gave 21 per cent. control. At harvest time, the area treated with BHC showed new and vigorous growth and very little Aphid damage, that treated with DDT and Lethane showed some Aphid injury, and that treated with DDT alone showed aphid injury ranging from severe to light. Treatment of several hundred acres of peas with a 1 per cent. DDT impregnated dust, applied at the rate of 40–50 lb. per acre from an aeroplane under ideal weather conditions, gave good commercial control. In general, applications of 1 per cent. impregnated DDT dust from ground machines were reported by growers to be better than applications from aircraft.

WOODRUFF (N.) & TURNER (N.). **The Effect of Particle Size on the Toxicity of DDT Diluents in Water Suspension.**—*J. econ. Ent.* **40** no. 2 pp. 206–211, 3 figs., 8 refs. Menasha, Wis., 1947.

In a study of the effects of diluents on the toxicity of DDT applied in water suspensions, mixtures of diluents and DDT were prepared by grinding in a mortar. Since further treatment of some mixtures that would not pass through the atomiser not only reduced clogging of the nozzle but also greatly increased the toxicity of the DDT residues to house-flies [*Musca domestica*, L.], more detailed investigations on the effect of particle size on toxicity were undertaken. The diluents used were diatomaceous earths, and samples of 50 per cent. mixtures of DDT with these were prepared by ball-milling, micro-pulverising through a fine mesh screen or impregnating by adding benzene solution of DDT to the diluent, drying, and micro-pulverising. The average size of the particles in microns ranged from 20–30 to 5–15. Also, three samples of 50 per cent. DDT of identical composition but with particle sizes averaging 25–35, 15–25 and 10–20 microns, respectively, were compared. All samples were suspended in water at concentrations of 0·5, 0·25, 0·125, 0·0625 and 0·0312 per cent. DDT, sprayed on glass slides for ten seconds, dried for 24 hours in a desiccator and tested against house-flies five days old, the flies being attracted to the treated surfaces by light. After two hours' exposure, the flies were fed with a solution of honey and water, and examination for mortality 24 hours later showed that at almost every concentration reduction in particle size produced increases in toxicity, and that these were greater than the differences in toxicity between different diluents with the same particle size. The fact that the toxicity with different diluents differed showed that factors other than particle size affect the toxicity of DDT and diluents in water suspension. Of the three samples of identical composition, that with the smallest particle size was the most toxic and that with the largest least toxic.

In field tests, potatoes were treated with sprays containing 2, 1, 0·5 or 0·25 lb. of mixtures of DDT and two of the best diluents per 100 U.S. gals. water at the rate of 200 U.S. gals. per acre on 4th, 11th and 25th June and 9th, 16th and 30th July. The first two sprays were against flea-beetles [? *Epitrix cucumeris*, Harr.], and a measurement of flea-beetle damage on 19th June showed variable results. The third was against leafhoppers [? *Empoasca fabae*, Harr.] and the last three against both, and estimation of tip-burn on 17th July and of damage by flea-beetles on 25th July showed that control tended to increase as the particle size of the powders decreased in both cases. The particle sizes are stated to be given in a table, but it has been omitted from the paper. The three materials of identical composition were applied on 16th and 30th July against flea-beetles, and again control was substantially affected by particle size. The detailed results are stated to be shown in a table and a figure, but these are not given. Smaller particle sizes usually produced greater yields, and the difference appeared to be of practical importance. No evidence was found of a change in particle shape due to either change in particle size or impregnation. Since there was such a high degree of correlation between the field and

laboratory tests, the authors consider that the laboratory method may be used with confidence to determine many phases of the toxicity of DDT mixtures.

Watkins (T. C.) & Norton (L. B.). **A Classification of Insecticide Dust Diluents and Carriers.**—*J. econ. Ent.* **40** no. 2 pp. 211–214, 7 refs. Menasha, Wis., 1947.

In the course of an investigation of physical and chemical properties and inherent toxicities of the materials used as diluents and carriers in insecticidal dusts, a system of classification was developed to aid in cataloguing and to show the relationships between materials that were apparently very different. It was based primarily on the mineral contents of the materials as given by various mineralogists, but modifications of their systems are suggested to provide for the few materials that fall outside the category of inorganic bodies. The commercially available materials were divided into botanical flours, including all materials that are directly of plant origin, and minerals, including artificial products as well as natural materials. Most of the botanical flours are merely dried and ground plants or plant parts that have been processed primarily for other uses, and they are generally employed as carriers for absorbing or adsorbing liquid insecticides and require additional quantities of diluents to meet the physical requirements of dusting machinery.

Mineral diluents are usually mixed, and these are classified with the mineral forming the largest proportion of the mixture, as in most instances one definitely predominates and is responsible for most of the properties of the mixture. Of the seven major groups of minerals comprising dust diluents, the oxides and the silicates are the most numerous. Representatives of the others are relatively few in number, and, in general, have found rather limited use. Sulphur is the only element used to any extent as a diluent, natural or synthetic calcium carbonate, which has had rather restricted use, chiefly because of its high bulk density, the only carbonate, gypsum the only sulphate, a synthetic material having the same empirical formula as the variety of apatite called hydroxy-apatite the only phosphate, and pumice the only representative of a group of materials termed by the authors indeterminate because they reveal no definite mineral patterns in spite of their inorganic origins. The oxides comprise silicon dioxide as tripolite and diatomite, and calcium oxide (or hydroxide) in calcium lime or magnesium lime, and the silicates comprise mica, talc, pyrophyllite and three groups of clays. Calcium limes are limes that contain less than 10 per cent. magnesium oxide and magnesium limes those that contain 10 per cent. or more.

Hunt (C. R.). **Toxicity of Insecticide Dust Diluents and Carriers to Larvae of the Mexican Bean Beetle.**—*J. econ. Ent.* **40** no. 2 pp. 215–219, 4 figs., 8 refs. Menasha, Wis., 1947.

In order to interpret toxicological results clearly, it is necessary to evaluate all factors that may influence the toxicity of the insecticide under consideration, including the effect of the diluent in dust mixtures. Mortality of larvae of the Mexican bean beetle [*Epilachna varivestis*, Muls.] due to the diluents became apparent during a preliminary investigation on the effects of climatic factors on the action of mixed dusts, and investigations were therefore carried out on the effect of larval age on susceptibility to dusts, the effects of temperature, humidity and light on the action of the diluents, and the effects of diluents on the toxicities of mixed dusts. The diluents used were commercial samples and received no further treatment before being applied by shaking from a small specimen vial covered with muslin or in a dust settling tower. Batches of ten larvae were allowed to feed on the dusted upper surface of each bean leaf and examined for mortality at intervals.

When larvae of various ages were kept on leaves dusted with Attaclay (an attapulgite clay) until complete mortality was obtained, it was found that susceptibility decreased in successive instars, though the old individuals in a given instar were more resistant than newly emerged larvae of the following instar. The mortalities of fourth-instar larvae observed in 68 hours at about 75°F. on leaves dusted with the 61 diluents available for test, and the classification in groups [*cf.* preceding abstract] of the latter, are given in a table. There were wide differences between the mortalities given by materials within some groups, indicating that the factors causing death were probably physical rather than chemical. Among the talcs, mortality ranged from zero to 50 per cent. and was generally highest for the spicular types. The members of the diatomite and attapulgite series all gave high kills, but in both groups the number of samples available was limited. None of the five botanical flours tested showed any effect, and the three forms of calcite (carbonate group) gave very low mortality.

The primary cause of death from the action of the diluent in an insecticide dust mixture is generally presumed to be desiccation, but it is necessary to consider the effect of abrasion on the entrance of the toxicant. To study this, tests were carried out with walnut-shell flour, which had caused no mortality in the previous tests and could be classed as a non-abrasive diluent, and a kaolinitic clay that had caused high mortality and could be classed as a material that might be abrasive to insects. The toxicants used were cryolite, at concentrations of 6·25 and 50 per cent. in both diluents, and rotenone at 0·75 per cent. in both, and all mixtures and the diluents alone were tested against fourth-instar larvae, at 90°F. and 38 per cent. relative humidity, at which the effects of desiccation should be pronounced, and at 75°F. and 75 per cent. relative humidity, at which they should be reduced. Mortality counts were taken at regular intervals until percentage kills were high. Mortality was greater under conditions of high temperature and low humidity for each mixture and material, with the exception of walnut-shell flour alone, which caused none under either set of conditions. It was also greater for mixtures containing the clay than for corresponding ones containing walnut-shell flour, the differences at low temperature and high humidity being equal to those at high temperature and low humidity or greater. At high temperature and low humidity, the mortality for clay alone approached that for the cryolite or rotenone mixtures in which it was used and was greater than for rotenone or cryolite mixtures containing walnut-shell flour, whereas at low temperature and high humidity the effect of the clay alone was very slow (120 hours for 50 per cent. mortality). Walnut-shell flour mixtures containing 6·25 per cent. cryolite or 0·75 per cent. rotenone were not toxic at low temperature and high humidity during the period of observation. It is clear that the toxicities of the dusts used in these tests were affected by the diluents. The high kill given by the clay alone where desiccation might be expected suggests that its effect in the mixtures under drying conditions might be due chiefly to desiccation, but since mixtures containing it were more toxic than those containing walnut-shell flour at the low temperature and high humidity, differences cannot be explained on the basis of desiccation alone, but may be due to the effect of abrasion in permitting more rapid penetration of the toxicant [*cf. R.A.E.*, A **34** 60, etc.]. It appears therefore that if abrasion is the primary action of a diluent in affecting mortality it may have at least two effects, desiccation and increased penetration of the toxicant, the relative importance of these depending on climatic conditions.

BROOKS (W.) & ANDERSON (L. D.). **Toxicity Tests of some new Insecticides.** —*J. econ. Ent.* **40** no. 2 pp. 220–228, 2 figs., 3 refs. Menasha, Wis., 1947.

The results are given of preliminary tests on the effectiveness of DDT, chlordane and BHC (benzene hexachloride) against various insects in Tidewater,

Virginia. In tests against *Diaphania nitidalis*, Stoll, on cantaloupe melons, which were treated soon after the first blossoms appeared and again ten days later, BHC dust (1 per cent. γ isomer) was the most effective, and an impregnated 1 per cent. DDT dust was more effective than a 2 per cent. mixed DDT dust but less so than 3 per cent. mixed DDT. Dusts containing 0·5 per cent. γ BHC, 90 per cent. cryolite or 5 per cent. chlordane were the least effective of those tested, but all gave significant reductions of infested melons. No foliage injury from any treatment was observed. On cucumbers, BHC dust (1 per cent. γ) caused a significant reduction in plant stand, and DDT and chlordane mixtures caused a slight chlorosis of the new leaves but no reduction in stand. BHC dust (1 per cent. γ) was effective against the melon Aphid [*Aphis gossypii*, Glov.] and the striped and spotted cucumber beetles [*Diabrotica melanocephala*, F., and *D. duodecimpunctata*, F.] on cucumber and cantaloupe melon, and a 1 per cent. DDT impregnated dust was effective against the beetles. In a large-scale test carried out by a commercial grower, BHC dust (1 per cent. γ) noticeably scorched the new growth of cucumbers when applied at about 30 lb. per acre, but 3 per cent. DDT and a cryolite mixture did not, and in greenhouse tolerance tests on three varieties of cantaloupe melon and two of cucumber, the same BHC dust severely injured new growth, while 3 per cent. DDT and 5 per cent. chlordane caused only very slight chlorosis and slight malformation of the new leaves.

When applied to spinach, heavily infested by *Hymenia recurvalis*, F., from a dust machine with a 12-ft. trailer, BHC dust (1 per cent. γ) gave complete control in 4 days and was significantly more effective than dusts containing 0·2 per cent. pyrethrins or 0·04 per cent. pyrethrins with 0·4 per cent. piperonyl cyclohexanone ; there was no significant difference between the two pyrethrum dusts, owing to the synergistic effect of piperonyl cyclohexanone, which was confirmed by the results of commercial applications. In laboratory tests, dusts containing 1 per cent. γ BHC, 0·2 per cent. pyrethrins or 0·04 per cent. pyrethrins with 0·5 per cent. piperonyl cyclohexanone gave 100, 88 and 92 per cent. control, respectively, in 24 hours. In another field test, carried out in the autumn of 1945, a pyrethrum dust and pyrethrum and DDT in aerosol form were very effective, a 10 per cent. DDT dust gave only fair control and a sabadilla dust mixture was ineffective.

In seed treatments on two varieties each of sweet maize, snap beans and lima beans, a 3 per cent. DDT dust and a BHC dust (0·3 per cent. γ) were applied at the rate of 175 lb. per acre in the rows at the time of planting, and a 10 per cent. DDT dust and a BHC dust (0·5 per cent. γ) were applied (with an adhesive agent) to the seeds, the former at the rate of about 7 lb. per bushel and the latter usually at 12 lb. BHC caused considerable reduction in germination of all varieties except one of snap beans and one of sweet maize, the latter of which received a very low dosage, when applied to the seeds, but injured only the sweet maize when applied in the row. DDT caused significant reductions in germination of one variety each of sweet maize and lima beans when the seeds were coated, but little or no injury when applied in the rows. Where the germination of the untreated seeds was poor, the injury resulting from the insecticides was greatly increased. After untreated and coated seeds had been stored for six months, the germination percentages of lima beans and the two varieties of snap beans were 80, 96 and 100 for no treatment, 0, 16 and 28 for BHC and 68, 88 and 68 for DDT, and that of sweet maize 80 and 0 for DDT and BHC.

In a small field test, sprays of 1 lb. wettable BHC powder (7·5 per cent. γ) per 100 U.S. gals. water, alone or with 2 U.S. quarts kerosene-type oil emulsion, and BHC dust (1 per cent. γ) gave 50, 46·8 and 86·6 per cent. kill of *Taeniothrips simplex*, Morison, on *Gladiolus*, when applied as the petals were beginning to show at the ends of the buds, whereas sprays containing 1 lb. DDT as wettable

powder or 1 U.S. quart 25 per cent. DDT emulsion concentrate per 100 U.S. gals. and an impregnated dust containing 1 per cent. DDT gave only 6·5–10·8 per cent. kill and 4 lb. tartar emetic with 6 lb. brown sugar per 100 U.S. gals. gave 4·1 per cent. The effectiveness of BHC dust was due to the volatility of the material, which killed the thrips within the buds, and some of the poor results given by the other materials may have been due to two showers of rain that fell in the three days between treatment and mortality counts. In a large-scale test, three applications of DDT and BHC sprays, applied at about 75 U.S. gals. per acre, gave approximately equal control, which was fair and was superior to that given by tartar-emetic spray.

In tests on potatoes infested by *Epitrix cucumeris*, Harr., and *Macrosiphum solanifolii*, Ashm., five applications were made at about weekly intervals from the time when the plants were in flower. Against the Aphid, a spray of 2 lb. wettable powder containing 50 per cent. DDT and 5 lb. neutral copper (approximately 50 per cent. metallic) per 100 U.S. gals. water was very effective and a dust containing BHC (12 per cent. γ), neutral copper and pyrophyllite (Pyrax ABB) (5 : 10 : 85) was superior to one of DDT, neutral copper and pyrophyllite (3 : 10 : 87). Against the flea-beetle, there was little or no difference between these dusts and one of calcium arsenate, monohydrated copper sulphate and lime (10 : 20 : 70), and a spray of 4 lb. calcium arsenate per 100 U.S. gals. Bordeaux mixture, the most effective material tested, was superior to the DDT spray possibly because it resulted in a much greater deposit on the foliage at the time of infestation.

In laboratory tests, kale leaves infested with *Rhopalosiphum pseudobrassicae*, Davis, were dusted by means of a small atomiser. Based on significant differences in mortality after 24 hours, BHC (1 per cent. γ) was superior to 3 per cent. nicotine, nicotine was better than 3 per cent. DDT or 5 per cent. chlordane, and the last two were not better than no treatment. Kale treated with BHC dust (1 per cent. γ) was cooked 48 hours later, and although the leaves were not washed, no musty odour could be detected during or after the cooking.

Tests on sweet maize for the control of *Peregrinus maidis*, Ashm., and *Laphygma frugiperda*, S. & A., were made on a late planting by applying dusts three times at intervals of one week from the time the maize was about three inches high with a hand rotary duster, the nozzle of which was directed at the whorl of the plant. Insect counts made after the third treatment indicated little difference in the effectiveness of BHC dust (1 per cent. γ), 3 per cent. DDT and 5 per cent. chlordane in pyrophyllite against *P. maidis* (79, 67 and 62 per cent. control) or *L. frugiperda* (94, 93 and 98 per cent.). A 1 per cent. DDT impregnated dust appeared to be less effective against *P. maidis* (45 per cent. control), but was not significantly inferior to 3 per cent. DDT against *L. frugiperda* (88 per cent.). Plots dusted with lead arsenate were more heavily infested by *P. maidis* than untreated plots, possibly because of the unattractiveness of the latter, and showed slight scorching and stunting ; the percentage control of *Laphygma* was 60. In the field, dust mixtures containing chlordane, DDT, BHC, cryolite and lead arsenate did not give effective control of larvae of *L. frugiperda* late in the fourth instar, possibly because they were ready to pupate and therefore more resistant to insecticides.

To test their effectiveness as barriers, the insecticides were applied at the rate of 28 oz. per 100 ft. in a furrow ploughed across the middle of a field of soy beans in which a heavy and uniform population of *L. frugiperda* had eaten all the self-sown grasses and was beginning to migrate. Counts 24 hours later of dead larvae in the furrow and within 6 ft. of it showed that BHC dust (1 per cent. γ) was significantly better (6·03 dead larvae per foot) than 5 per cent. chlordane (2·54), but not than 3 per cent. DDT (4·29). Rain fell six hours after the dusts had been laid and the effectiveness of all of them 24 hours later was greatly reduced by caking.

Poison baits were tested against *L. frugiperda* and *Agrotis ypsilon*, Hfn. In tests in which ten larvae of *L. frugiperda* were caged with natural food for 24 hours and a small amount of bait that was removed after four hours, baits of chlordane, xylene, oil and bran (1·5 : 5 : 11 : 82·5) were significantly better than any others tested (100 per cent. kill), and baits of DDT, xylene or Velsicol AR-60, oil and bran (1·5 : 5 : 11 : 82·5) or of DDT, Velsicol AR-60 or oil and bran (1·5 : 16 : 82·5) were about as effective as those of Paris green, oil and bran (3 : 16 : 81) (55–72 per cent. kill). One of enough BHC to give 0·2 per cent. γ isomer, 5 per cent. xylene, and 11 per cent. oil in bran was significantly less effective (44 per cent. kill) than all but two of the others. When the bait was scattered round marked stakes set at points selected at random within a field infested by *L. frugiperda* and the numbers of larvae within areas of four square feet were counted after 24 and 48 hours, the bait containing 1·5 per cent. chlordane was significantly superior (93 per cent. kill) after 48 hours, and those containing BHC and 1·5 per cent. DDT with 16 per cent. Velsicol were significantly inferior (36 and 20 per cent. kill) to that containing Paris green (63 per cent. kill) or 1·5 per cent. DDT and 5 per cent. Velsicol (62 per cent.). The other baits ranged in effectiveness between chlordane and Paris green. Tests in which third- and fourth-instar larvae of *A. ypsilon* were caged for 48 hours with a partly grown kale plant outside a ring of bait placed round the stem and about two inches from it showed that a bait containing DDT, xylene, oil and bran (3 : 5 : 11 : 81) was significantly better (80 per cent. kill) than the Paris green bait (27 per cent. kill) and that DDT, xylene, oil and bran (1·5 : 5 : 11 : 82·5) and two chlordane baits (1·5 and 3 per cent. with 5 per cent. xylene and 11 per cent. oil in bran) were not significantly superior to Paris green and not significantly inferior to 3 per cent. DDT. All these poison baits were significantly better than bran containing 17 per cent. oil. The BHC bait was unattractive and ineffective.

In small scale laboratory and field tests, BHC dust (1 per cent. γ) and a spray of 4 oz. BHC (30 per cent. γ) per 100 U.S. gals. water were effective against adults of the Japanese beetle [*Popillia japonica*, Newm.]. Tests against beetles with DDT sprays from wettable powders and emulsion concentrates indicated that the powders were superior on the basis of equal DDT content. In the laboratory, BHC dust (1 per cent. γ) was effective against nymphs and adults of the harlequin cabbage bug [*Murgantia histrionica*, Hahn], and a bait containing 0·2 per cent. γ BHC was attractive and very toxic to a group of mixed species of grasshoppers. BHC dust was inferior to DDT and chlordane against the imported cabbage worm [*Pieris rapae*, L.].

Hoffmann (C. H.), Hepting (G. H.) & Roth (E. R.). **A Twig Droop of White Pine caused by** *Pineus*.—*J. econ. Ent.* **40** no. 2 pp. 229–231, 3 figs., 1 ref. Menasha, Wis., 1947.

The author describes a form of injury found on white pine [*Pinus strobus*] in North Carolina in the spring of 1943. The twigs were sharply bent down, either at the base of the current year's growth, in which case they were limp, or at an internode that had developed 1–3 years before examination, in which case the growth after the bend was usually greatly reduced. Examination of the stand in June showed that injury was specially common among small trees growing in the shade, a few of which had died, and on twigs of the lower branches of larger trees. The branch terminals of some malformed trees were heavily infested with Chermesine Aphids, but others were uninfested. Immature Aphids in several stages associated with the crooked terminals were identified as *Chermes* (*Pineus*) *strobi*, Htg. Since this species had not previously been observed to cause such a deterioration, and since no disease was known to do so, other causes, such as sleet or snow, were sought, but the evidence indicated

that the damage was caused in early summer or spring, and that the associated Aphids were probably involved. Late in February 1944, some of the older needles had dropped and a few of the terminals on some trees had died, but no branch breakage was observed. First-stage Aphids in the crooked terminals of bowed branches were identified as a species of *Chermes* (*Pineus*) differing from known stages of *C. strobi* and apparently not agreeing with the described stages of any known species. Only a few were alive. Similar damage to white pine was observed in Quebec, and, in association with *Chermes* (*Pineus*) sp., in two other localities in North Carolina and on one tree in Ontario, and somewhat similar damage by *C.* (*P.*) *pinifoliae*, Fitch, has been recorded in New Brunswick [*R.A.E.*, A **32** 110].

To determine whether the Aphids were responsible for the damage, some of the affected trees or branches of trees were sprayed with white-oil emulsion containing nicotine sulphate and soap flakes on 7th July and 29th August 1944 and on 29th June 1945. Examination on 27th April 1945 showed no Aphids on the treated trees but large numbers of all stages on untreated ones, and examination on 20th September 1945 showed no twig droop and greater growth than in 1944 on treated trees but a high proportion of drooping twigs on unsprayed ones. It was therefore concluded that a form of *Chermes*, representing either unknown stages of a recognised species or a new species, is the cause.

WOODSIDE (A. M.). **Weed Hosts of Bugs which cause Cat-facing of Peaches in Virginia.**—*J. econ. Ent.* **40** no. 2 pp. 231–233, 4 refs. Menasha, Wis., 1947.

The following is based on the author's summary. Cat-facing of peaches, caused by species of *Euschistus* and *Lygus oblineatus*, Say, has resulted in considerable losses in Virginia in recent years. Since these bugs do not breed on peach and have not been found in significant numbers on any cover crop except scattered plants of sweet clover [*Melilotus*], an attempt was made to determine their principal food-plants. It was found that *Euschistus* breeds heavily on *Erigeron annuus*, *E. canadensis*, *Lychnis alba* and *Verbascum thapsus* [*cf. R.A.E.*, A **35** 250], whereas *Lygus oblineatus* prefers *E. annuus*, *E. canadensis*, *Lychnis alba*, *Chrysanthemum leucanthemum*, *Aster vimineus*, *Amarantus retroflexus*, *Ambrosia artemisifolia* and *Chenopodium album*, but breeds on almost any weed. Weeds are apparently much more important as sources of these bugs than are cover crops, and it is recommended that where cultivation is not practised weeds should be kept mown to reduce breeding.

HAMILTON (D. W.). **New Insecticides for Control of Pear Psylla.**—*J. econ. Ent.* **40** no. 2 pp. 234–236, 1 ref. Menasha, Wis., 1947.

In view of the shortage of nicotine sulphate and the need for more effective insecticides for use against *Psylla pyricola*, Först., on pear in the Pacific Northwest, new materials were tested in commercial plantings of pears in New York in 1943–46. A processed dry concentrate containing 14 per cent. nicotine, used at 3 lb. per 100 U.S. gals., gave about 90 per cent. reduction of nymphs, and compared favourably with nicotine sulphate (1 : 800) in various standard spray mixtures, especially when used with 9 lb. hydrated lime per 100 U.S. gals.; neither form killed many adults. The reductions given by the nicotine sulphate mixtures sometimes exceeded 95 per cent. but varied widely, probably owing to differences in temperature in some instances, emphasising the need for an insecticide more consistently effective under all conditions likely to be encountered in the control of the Psyllid. A ground cubé root (5 per cent. rotenone), used at 1½ or 3 lb. per 100 U.S. gals. and a commercial paste containing 50 per

cent. cubé root at 1 or 1½ lb. per 100 U.S. gals., alone or with emulsifiable oil, were about equal to nicotine in controlling the nymphs; the addition of ½ lb. soy-bean flour did not increase the effectiveness of the ground root. The latter killed few adults, but the commercial paste killed many more, especially when used with oil.

A commercial wettable powder said to contain 31·6 per cent. benzene hexachloride with a γ isomer content of 12 per cent. gave 98 per cent. or more reduction of nymphs in the laboratory and in the field at concentrations as low as 2 lb. per 100 U.S. gals., and when it was used with emulsifiable oil, it also killed large numbers of adults. As it imparted a musty flavour to the fruit, it should be used only early in the season. Pears sprayed on 19th July had a calculated residue of 0·95 part benzene hexachloride per million on 26th September, and those sprayed on 19th July and 16th August had 1·31 p.p.m.

Sprays containing 8 oz. technical hexaethyl tetraphosphate and 2 oz. Triton B-1956 or 1 U.S. pint of an emulsion concentrate of technical hexaethyl tetraphosphate and Triton B-1956 dissolved in xylene (50 : 10 : 40 or 50 : 5 : 45) per 100 U.S. gals. were rather less effective against the nymphs than nicotine sulphate in one test and rather more so in another at a lower temperature. A spray of 1 pint per 100 gals. of a commercial mixture containing 50 per cent. hexaethyl tetraphosphate, alone or with 1 gal. emulsifiable oil, was also effective in the latter test, but only the mixture with oil gave a good kill of adults. These sprays did not injure pear foliage or affect the operators when applications were made in the usual way.

A proprietary material reported to contain 8 per cent. "piperonyl cyclohexenone" and 0·8 per cent. pyrethrins reduced Psyllid nymphs by 89·5 per cent. when used at 1 pint per 100 gals. and by 87·2–99·3 per cent. at 1 quart per 100 gals., killed large numbers of adults and did not injure pear foliage.

Materials that proved comparatively or entirely ineffective and (in brackets) the rates at which they were used per 100 U.S. gals. included DDT (1 lb.), tank-mixed nicotine bentonite (1 U.S. pint nicotine sulphate, 8 lb. Mississippi bentonite and 1 U.S. quart soy-bean oil), *Ryania* wood (6 lb.), *Ryania* extract (containing the equivalent of 5 lb. wood, 1 U.S. quart), sabadilla (5 lb. of 50 per cent. powder), emulsifiable mineral oil (1 U.S. gal.), dicyclohexylamine salt of dinitro-o-cyclohexylphenol (20 oz.), lauryl isoquinolinium bromide (1 U.S. pint) and phenothiazine (2 lb.).

Bromley (S. W.). **Recent Advances in Control of Ornamental and Shade Tree Insects.**—*J. econ. Ent.* **40** no. 2 pp. 237–239. Menasha, Wis., 1947.

The author summarises recent experience in the use of new insecticides against pests of shade trees and ornamental plants in the north-eastern United States. A resin emulsion of pyrethrum and rotenone has been found to control a number of injurious Arthropods without damaging the trees or leaving an unsightly residue. Four applications of the emulsion to all the shade trees, shrubberies and flower beds round a house, made on 22nd May, and 2nd, 12th and 17th July at a concentration of 1 : 100 gave excellent control of *Hoplocampa testudinea*, Klug, and *Rhagoletis pomonella*, Walsh, on astrakhan apple [*Pyrus malus* var. *astracanica*], *Anuraphis roseus*, Baker, and *Lygidea mendax*, Reut., on apple, *Paratetranychus pilosus*, C. & F., on apple and cherry, *Tetranychus bimaculatus*, Harvey, on phlox, *Aphis spiraecola*, Patch, on bridal wreath [*Spiraea vanhouttei*], a black Aphid on dahlia and nasturtium, *Caliroa aethiops*, F., *Macrosiphum rosae*, L., and *Typhlocyba rosae*, L., on rose, *Nematus* (*Pteronidea*) *ribesii*, Scop., on gooseberry, and *Empoasca fabae*, Harr., on dahlia. Adults of *Popillia japonica*, Newm., were not killed to any extent, but forsook the sprayed plants for several days after each application. The maximum of flight and feeding by the beetles did not come until the third week in August

at North Stamford, Connecticut, in 1946. One application on 13th July of a spray of 5 lb. amorphous diatomaceous silica and 1 lb. alkyd resin binder per 100 U.S. gals. to all plant growth over a considerable area repelled the beetles satisfactorily until new growth appeared in about a fortnight, and local applications of 1 lb. actual DDT (in a water-dispersible powder) per 100 U.S. gals. controlled these foci of infestation for about another two weeks.

In Massachusetts, atomised sprays of DDT dissolved in xylene and diluted with kerosene to 10 per cent. gave excellent control of small larvae of *Lymantria* (*Porthetria*) *dispar*, L., in 1946 before they injured the foliage, and protected treated trees, shrubs and small plants throughout the entire season. It was not necessary to cover the foliage with DDT, as the wandering habit of the young larvae causes them to crawl over a film of the poison if the trunk was well covered with it. A 50 per cent. water-dispersible DDT powder applied as a dust or in concentrated sprays by a mist power blower in June 1946 had no effect on *Thyridopteryx ephemeraeformis*, Haw., on a variety of trees and shrubs at Cynwyd, Pennsylvania. An application of DDT in dust and solution form from a turbine blower to all growing plants in an area in North Stamford on 30th April destroyed great numbers of pollinating insects on flowering shrubs and plants, and as a result of this and of the rainy, windy weather, no crop was obtained on some varieties of apple. A single application of a spray of 1 lb. actual DDT (in a water-dispersible powder) per 100 U.S. gals. to elm trees at Greenwich, Connecticut, on 6th July 1945, when the larvae of *Galerucella luteola*, Müll. (*xanthomelaena*, Schr.) were about three-quarters or more grown, gave such good control that no treatment was necessary in 1946, although trees that had not been sprayed were defoliated.

A benzene-hexachloride dust containing 1 per cent. γ isomer, applied with a hand duster, caused no foliage injury to 40 trees and shrubs, which are listed, and gave complete control of *Eriosoma crateagi*, Oestl., on hawthorn [*Crataegus*], and *Hyphantria cunea*, Dru., on apple, and of *P. japonica* for two weeks on Siberian elm (*Ulmus pumila*), but very little control of *Empoasca maligna*, Walsh, was apparent on apple three weeks after application. Unfavourable factors in the use of this material appeared to be the unsightly residue left on the foliage and the musty odour, which persisted for a fortnight or more, depending on weather conditions.

GADDIS (C. H.) & GOODHUE (L. D.). **Treatment of Aeroplanes to prevent accidental Transportation of Japanese Beetles.**—*J. econ. Ent.* **40** no. 2 pp. 240–244. Menasha, Wis., 1947.

During the war it was difficult to prevent the accidental transport of adults of *Popillia japonica*, Newm., in military aircraft from certain airports in the United States that were in a congregation zone of this insect, preventive measures consisting solely of hand-picking the beetles out of the aeroplanes or of keeping the cabins closed while they were on the ground. Tests were therefore made in May–August 1945 on the use of insecticides for this purpose. In laboratory tests, complete mortality of adults was obtained with aerosols containing 6 per cent. DDT, 6 per cent. DDT with 4 per cent. pyrethrum extract (20 per cent. pyrethrins) or 3 or 6 per cent. DDT with 2 per cent. pyrethrum extract, but not with one containing 2 per cent. pyrethrum extract only. In only one case did complete kill occur within 24 hours, but all dosages of aerosols containing DDT inactivated the beetles immediately, so that they remained moribund until death or the end of the experiment (6 days). A dosage as small as 6·6 gm. per 1,000 cu. ft. of an aerosol containing 3 per cent. DDT was as effective as 176 gm. of one containing 6 per cent. DDT. With pyrethrum alone, the beetles that did not die began to feed after one or more days and appeared normal in behaviour.

On the basis of these results, an aerosol mixture of pyrethrum extract (20 per cent. pyrethrins), DDT, APS 202 (an aromatic petroleum fraction) and dichlordifluoromethane (2 : 3 : 15 : 80) was used for further tests. When this was applied at the rate of 8·8 gm. per 1,000 cu. ft., it killed all beetles exposed to it for from 5 seconds to 30 minutes in 3–5 days, showing that a lethal dose was deposited on them when the aerosol was applied. In 30 tests under various conditions in all types of military aircraft, dosages of 7·5–50 gm. in the cabin caused complete mortality in 1–4 days of free-flying adults exposed for 15 minutes.

In laboratory tests of DDT deposits, successive lots of beetles were caged for 30 minutes at various intervals after application on the residues from a dust of 10 per cent. DDT in talc or from spray concentrates of DDT, APS 202 and deodorised kerosene (15 : 50 : 35), DDT, orthodichlorbenzene and deodorised kerosene (15 : 40 : 45) or DDT, Triton and APS 202 (22·5 : 10 : 67·5) diluted with water (1 : 3) on unpainted plywood or corrugated rubber matting. All residues tested continued to give complete mortality on plywood for more than 100 days. The sprays were not effective on the rubber, apparently because they were absorbed by it, but the dust was effective after 30 days, the longest period tested on this material. Residues from aerosols containing 6 per cent. DDT or 3 per cent. DDT and 2 per cent. pyrethrum extract, tested by hanging sections of plywood and rubber in the exposure chamber during application and later confining beetles on their surfaces for 30 minutes, were not toxic at successive rates of 44 and 66 gm. per 1,000 cu. ft., but an additional exposure to 88 gm. making a total of 198 gm. per 1,000 cu. ft., produced a toxic residue that remained effective for 98 days on plywood, though it was not effective on the rubber, indicating that repeated applications of an aerosol would eventually build up a toxic residue on wooden surfaces.

GRAYSON (J. M.) & POOS (F. W.). **Southern Corn Rootworm as a Pest of Peanuts.**—*J. econ. Ent.* **40** no. 2 pp. 251–256, 1 fig., 7 refs. Menasha, Wis., 1947.

The larvae of *Diabrotica duodecimpunctata*, F., are potentially serious pests of groundnuts in Virginia [*cf. R.A.E.*, A **4** 390], and have recently caused considerable injury to them. They bore into the pods and feed on the kernels and on the more succulent tissue of the surrounding pod, and predispose it to decay from soil micro-organisms, even when the amount of feeding is not serious. The pods are highly susceptible to injury from the time they begin to form in the soil until they approach maturity, and the tips of the shoots or " pegs " are sometimes attacked and killed before they enlarge to form pods.

Surveys in three or four counties showed that the amount of injury at harvest increased from a low level in 1944 to an average of about 12 per cent. in 1945 and over 28 per cent. in 1946. Observations on the type and physical condition of the soil, the extent of plant growth and the proximity of growing maize, made in an attempt to evaluate indirect factors that might influence the extent of injury caused by *D. duodecimpunctata* to groundnut pods, indicated that the most important factor was the physical condition of the soil as influenced by the amount and timing of rainfall throughout the growing season. Injury was generally more severe in moderately stiff soils that had a tendency to remain moist than in well drained light ones, though it was by no means restricted to the former. No positive correlation was found between soil type and amount of organic matter and injury, except indirectly because drainage is important in producing different soil types, and the proximity of maize appeared to have little if any effect on the amount of injury. More injury was usually observed in fields with good plant growth than in those with poor growth.

Insectary and field observations in 1945 and 1946 indicated that oviposition by overwintered females began towards the middle of March and that there were three generations a year, of which the adults emerged in the first three weeks of June, in late July and in September–October, respectively. No eggs were laid by the third generation in the autumn. In laboratory tests, adults were caged for at least two weeks over soil containing DDT or BHC (benzene hexachloride), thoroughly mixed with the top 1½–2 inches, and the numbers of larvae in the soil were determined by sieving it 10–14 days after the removal of the adults. Concentrations of 5–100 lb. DDT and 5–50 lb. BHC (30 per cent. γ isomer) per acre gave complete control except for the survival of a single larva in one test. The soil treated with the higher rates of BHC appeared to be toxic to the adults caged over it. In preliminary field tests in 1945, applications of 50 or 100 lb. DDT per acre on 30th July gave considerable control of the larvae, whereas 25 lb. per acre gave only slight control, possibly for lack of thorough mixing in the soil, though leaching or direct sunlight may have caused the loss or deterioration of DDT. In 1946, DDT at 25, 50 and 100 lb. per acre reduced the numbers of injured pods by 49·5, 68·0 and 84·4 per cent. when applied on 16th June and by 47·5, 61·9 and 74·3 per cent. when applied on 11th July. The differences between even the least effective treatments and none were highly significant, but there was no significant difference between the results obtained from 25 and 50 or 50 and 100 lb. per acre on either date of application. When the results of both dates were combined, however, the differences between treatments were significant. The combined analysis also showed that the treatments applied on 18th June were significantly better than those applied on 11th July. A small-scale test in 1945 indicated that three applications of mixtures of up to 5 per cent. DDT in sulphur to groundnut foliage gave very little control. In 1946, treatment of the foliage on 12th and 29th July and 21st August with sulphur alone or sulphur containing 1 or 2 per cent. DDT, or with sulphur containing 2 per cent. DDT on the first two dates and sulphur alone on the third, reduced the numbers of injured pods by 17·9, 26·7, 37·7 and 32·7 per cent., respectively ; the differences between treatments were not significant. Spraying with a suspension of 0·66 per cent. DDT against tobacco thrips [*Thrips tabaci*, Lind.] on 18th and 23rd June and 7th July 1945 reduced infestation by *D. duodecimpunctata* by 52 per cent., and five applications of pyrophyllite dust containing 2 per cent. DDT in 1946 reduced it by 85 per cent., indicating that a combined programme against the two pests might give greater reduction in pod injury than treatment against *Diabrotica* alone.

In preliminary tests on the effect of the insecticides on germination and growth of seedlings of maize, cotton, groundnuts and soy beans, the soil was treated with 200 lb. DDT or 100 lb. BHC (30 lb. γ isomer) per acre, applied by hand and hoed into the top 1½–2 ins., and seed was sown 1 or 10–12 days later. DDT had no effect on germination or subsequent growth. BHC caused almost complete kill of maize soon after germination in both tests, and reduced germination and survival to 85 and 20 per cent. for groundnuts, 90 and 54 per cent. for cotton and 88 and 56 per cent. for soy beans sown one day after application ; when the seed was planted 10–12 days after treatment, BHC reduced germination and survival to 88 and 27 per cent. for groundnuts and to 79 and 56 per cent. for cotton and permitted good germination but only 34 per cent. survival of soy beans.

HARMAN (S. W.). **An Analysis of the DDT Spray Program for controlling Codling Moth.**—*J. econ. Ent.* **40** no. 2 pp. 256–258, 1 fig., 1 ref. Menasha, Wis., 1947.

In New York, where the normal seasonal programme against the codling moth [*Cydia pomonella*, L.] on apple includes five cover sprays, investigations

were carried out in 1946 in which plots were treated with the individual cover sprays and various combinations of them to find which were the most important and what amount of residue they left on the fruit at harvest. The results are given in tables. The sprays contained 1 lb. DDT per 100 U.S. gals., either as a 50 per cent. wettable powder or as 1 lb. of the technical compound dissolved in 1 U.S. quart benzene and emulsified with 2–3 oz. Triton B-1956, and three applications were made, on 17th June and 1st and 12th July, against the first generation and two, on 6th and 21st August, against the second. The control obtained indicated that in that season the third and second cover sprays were the most effective in preventing infestation, the fourth next in importance, and the fifth and first least protective. As there was considerable variation in infestation in different parts of the orchard, the results probably only suggest trends, and as the season of 1946 was unusual, the relative importance of the sprays may be different under more normal conditions.

The full programme of five DDT sprays resulted in less than 1 larva per 100 apples and no superficial injuries as compared with 16 larvae and a number of superficial injuries for a programme of five sprays of 3 lb. lead arsenate per 100 U.S. gals. applied at intervals of approximately two weeks. On trees that received five wettable-powder sprays, the spray residue (0·021 grain per lb.) was well below the tentative tolerance (0·05 grain) on all fruit after the customary handling during the harvesting operation on 16th September, but approached or exceeded it (0·043–0·064 grain) on fruit that was removed from the tree in such a manner as to avoid disturbing the deposit, and on those treated with five emulsion sprays it was 0·045 grain per lb. on carefully removed fruit. Without exception the last applications in the spray schedules were responsible for the heaviest deposits on the fruit at harvest, and it was apparent that an interval of about a month between the final spray and harvest was desirable after a programme of five DDT sprays under the present tolerance requirements.

Ingle (L.). **Toxicity of Chlordane to White Rats.**—*J. econ. Ent.* **40** no. 2 pp. 264–268, 3 refs. Menasha, Wis., 1947.

The following is the author's summary. Chlordane and DDT, compared weight for weight, appear to be of the same order of toxicity to white rats, when administered as acute and repeated intragastric dosages and when inuncted percutaneously as an oil solution, emulsion concentrate and dilutions of the emulsion concentrate. Rats receiving either chlordane or DDT present a wide range of individual susceptibility, which makes it difficult to establish an absolute minimum or median lethal dose. Anorexia, loss of weight, hyperexcitability, and tremors were symptoms produced by both compounds. Tonic and clonic contractions were slightly more severe for those treated with chlordane. The time lapse between administration of an acute lethal dose and death is longer for chlordane than for DDT-treated rats. There is some indication that chlordane may be slightly more toxic to female rats than to males. This was not observed to be true for DDT-treated rats. Chlordane appears to produce in rats less liver damage but greater pulmonary damage than DDT.

Langford (G. S.) & Squires (D. W.). **DDT, Benzene Hexachloride and Chlordane for Japanese Beetle Control.**—*J. econ. Ent.* **40** no. 2 pp. 269–270. Menasha, Wis., 1947.

Investigations were carried out in Maryland in the summer of 1946 on the relative effectiveness of technical DDT, BHC (benzene hexachloride) containing 10 per cent. γ isomer and technical chlordane in sprays against adults of the Japanese beetle [*Popillia japonica*, Newm.] All three materials were used at

a concentration of 1 lb. per 100 U.S. gals. water and all were effective, but there were marked differences in the speed of knockdown, residual effect and repellent value. The sprays were prepared from emulsion concentrates made by dissolving the compounds in xylene and adding Triton X 100 as the emulsifier (20 : 60 : 20) and from wettable powders containing 50 per cent. DDT or BHC. Comparative tests in commercial orchards indicated that all three insecticides could be used to protect foliage and ripening peaches and apples ; sprayed fruit and foliage was freed of beetles, dead and dying beetles were abundant in the sprayed plots, and sprayed foliage was obviously repellent. Knockdown was most rapid with DDT and BHC in emulsions, followed by BHC and DDT suspensions. Chlordane was quite slow in action. Laboratory tests to ascertain the differences in speed of knockdown for the different treatments, in which the beetles were dipped in the insecticide for five seconds, immediately dried on blotting paper and put in clean cages, showed the average knockdown times to be 10·5 and 16·7 minutes for DDT and BHC in the emulsions and 27·8 and 24·8 minutes for DDT and BHC suspensions, respectively. With chlordane, total knockdown was often not obtained in 2–4 hours. All three insecticides had a repellent effect, but the period of protection varied considerably. The cool wet weather that prevailed during the tests caused rapid plant growth, which combined with heavy beetle populations to cause a rapid return to all sprayed plants. Regardless of the spray used, they returned to new and unsprayed growth in 4–10 days, and this made it difficult to determine exactly the relative repellent values of the different materials. Daily examination of the numbers of beetles resting on sprayed and unsprayed foliage indicated that suspensions of DDT and BHC had more lasting repellency than emulsified solutions of these compounds or of chlordane, DDT being possibly slightly more lasting in effect than BHC in water suspensions. The dried residues of all the compounds were toxic to the beetles, which were observed dying on and under treated foliage for 6–10 days after spraying. In laboratory tests in which beetles were exposed for one minute to freshly dried residues, obtained by dipping leaves in the spray solutions, the control percentages after 24 hours were 99·5 and 95·8 for suspensions of BHC and DDT, and 70·8, 57·5 and 50·9 for emulsified solutions of BHC, DDT and chlordane. Tests with leaves collected at random from grapes sprayed in the field showed that the toxicity of each residue decreased as it weathered and aged, and that the rate at which beetles were overcome or died followed very closely the period of time for which they were exposed to the residue. At the end of 15 days, during which it rained on four occasions, the residues from all the materials but BHC suspension, which was not tested, showed toxicity when beetles were exposed continuously for 24 hours on sprayed leaves, but only those from the DDT suspension gave repeated high average kills. The percentage mortality for this spray averaged 91·6 for the 15-day period. When the beetles were exposed to sprayed foliage for five minutes, the emulsion deposits became very inefficient and erratic in effect after the third day, average mortality dropping to less than 30 per cent., whereas the DDT suspension gave more than 90 per cent. mortality for the first six days.

GOODEN (E. L.). **Evaluation of Pyrophyllite as an Insecticide Diluent.**—*J. econ. Ent.* **40** no. 2 pp. 270–273, 3 figs., 4 refs. Menasha, Wis., 1947.

In any critical research designed to evaluate pyrophyllite as an insecticide diluent, care should be taken to ensure that the material used is actually pyrophyllite of a reasonably pure grade, and any reference minerals used (such as talc or kaolin) should be of similar grade, particularly with regard to quartz content. The author points out some precautions that should be taken in standardising pyrophyllite. Such standardisation is somewhat difficult, as the naturally occurring mineral is often very impure [*cf. R.A.E.*, A **34** 231 ;

35 392] and it may easily be confused with mica or talc and may contain a considerable proportion of quartz or be practically free from it. Methods of distinguishing between the minerals and of removing quartz from pyrophyllite are mentioned, and X-ray diffraction patterns for quartz and for pyrophyllite, talc and kaolin of different degrees of purity are shown.

YETTER jr. (W. P.). **New Insecticides for Control of the Oriental Fruit Moth.**—*J. econ. Ent.* **40** no. 2 pp. 274–275, 1 fig. Menasha, Wis., 1947.

Tests were made in New Jersey in 1946 to determine whether a single spray of DDT or its methoxy analogue (dimethoxydiphenyltrichlorethane), applied against third-generation larvae of *Cydia* (*Grapholitha*) *molesta*, Busck, about three weeks before harvest would reduce the infestation of ripe peaches. Two orchards were treated with a spray of 5 lb. per 100 U.S. gals. of a commercial wettable powder said to contain at least 16 per cent. DDT and 20 per cent. of an acaricide (technical hydroxypentamethylflavan). The treatment resulted in estimated reductions in infested fruit of 53 per cent. in one orchard and 80 per cent. in the other, these differences being not significant and highly significant, respectively. Another orchard sprayed with a wettable powder said to contain at least 50 per cent. methoxy analogue (technical) at the rate of 2 lb. per 100 U.S. gals. showed 31 per cent. reduction in infested fruits, which was not significant. No spray injury to fruit or foliage occurred in any of the plots. Although the hot dry summer was very favourable for mite development, there was less than 1 mite per leaf at the time of spraying; 10–14 days later there was a slight increase in all plots, and a month after spraying mites could be found on most of the foliage, but were not numerous enough to be considered important; the average numbers per leaf were then 8·48, 19·1 and 10·48 on sprayed trees in the three orchards, respectively, and 5·96, 6·58 and 3·34 in the controls. The population would probably have been higher but for several driving rains during the second half of August, and there seems to be no doubt that there was a substantial increase of mites on the foliage sprayed with DDT in spite of the acaricide included with it.

Analysis of the residue on fruit from the first orchard showed 15·1 parts DDT per million one day after spraying, but only 2·85 p.p.m. at harvest, as compared with the accepted tolerance of 7 p.p.m.

BROWN (A. W. A.) & HURTIG (H.). **Organic Insecticides for the Lesser Migratory Locust.**—*J. econ. Ent.* **40** no. 2 pp. 276–277. Menasha, Wis., 1947.

As a preliminary to field tests in Canada on the control of grasshoppers with oil sprays from aircraft and with oil aerosols from steam generators, laboratory tests were made with oil solutions of DDT, benzene hexachloride, 3,5-dinitro-o-cresol [numbered with CH_3 as 1], chlordane and phenothiazine against last-stage nymphs and young adults of *Melanoplus mexicanus mexicanus*, Sauss., which showed the same degree of susceptibility. The insecticides were dissolved in mixtures of solvents in varying proportions as dictated by their solubilities, and sprays containing 1–10 per cent. poison were applied by means of a nasal atomiser into a standard Peet-Grady chamber for periods varying from ten seconds to four minutes. The test material was exposed at a point where the diameter of the falling droplets averaged 40 microns. Observations for mortality were made daily for three days. Treatments were also made with the solvents alone, and corrections made for the mortalities caused by them.

In the first series of tests, wheat foliage was exposed to the spray, untreated grasshoppers were subsequently fed on it and corrected mortalities were

plotted against deposit on graphs. The median lethal deposits in lb. per acre were found to be 0·33 for chlordane dissolved in a mixture of xylene and kerosene (1 : 3), 7·4 for benzene hexachloride (10 per cent. γ isomer) dissolved in 1,4-dioxane and 8·7 for DDT (71 per cent. p,p′) dissolved in a mixture of xylene and kerosene (1 : 4). A deposit of 6·8 lb. per acre of dinitro-o-cresol dissolved in xylene and kerosene (1 : 2) caused 25 per cent. mortality, and deposits of up to 10·2 lb. per acre of phenothiazine dissolved in a mixture of xylene, Mentor 29 oil and acetone (1 : 3 : 2) caused none. In the second series, both grasshoppers and food were sprayed, and the median lethal deposits in lb. per acre were found to be 0·1 for chlordane, 0·22 for dinitro-o-cresol, 0·3 for benzene hexachloride, and 1·14 for DDT. Phenothiazine was again ineffective. All dosages given are of the commercial products.

BRUCE (W. N.). **Aphid Barrier for the Laboratory.**—*J. econ. Ent.* **40** no. 2 p. 277, 1 fig. Menasha, Wis., 1947.

To make the barrier described, strips of plastic 0·75 in. wide with a wire (No. 28 Chromel) cemented into a groove near one edge are formed into rings 1 ft. in diameter and cemented on to glass plates with the wire near the upper inner edge. The wires in 12 or 13 rings are connected in a series with 110 volts to consume about 0·7 amperes of current and use approximately 75 watts per hour. The heat produced in operation is hardly detectable with the hand, but it is very repellent to Aphids, which will not cross it even when affected by toxicants. Several species of Aphids have been confined within such barriers successfully, and ants, firebrats [*Thermobia domestica*, Pack.] and cockroaches [*Blattella germanica*, L.] may be confined if the heat is increased by reducing the number of barrier rings in the circuit.

STAFFORD (E. M.). **Possible Control of some Insects by killing the Males.**—*J. econ. Ent.* **40** no. 2 p. 278, 1 ref. Menasha, Wis., 1947.

During investigations on *Parlatoria oleae*, Colv., in California, certain large and distorted scales of females were observed under spiders' webs on leaves in the field. In an attempt to find an explanation of such abnormal individuals, a twig of Italian jasmine [*Jasminum humile*] was infested with *P. oleae* in the spring of 1943. As soon as the immature males could be recognised, they were removed from the twig, and this, infested only with females that were not fertilised, was isolated in a glass cylinder. The females matured normally, but the formation of their scales did not cease when the normal shape and size were reached, further increase in size being accomplished in various ways. The bodies retained their normal shape, but no eggs were formed, and the females, which often got completely outside their scales, remained alive nearly all the summer, whereas first-generation females normally die in midsummer.

Single applications of DDT sprays have not given satisfactory control of *P. oleae*, and the crawlers are apparently able to establish themselves on plants sprayed with DDT, but this compound showed great promise for the control of *Saissetia oleae*, Bern. [*cf. R.A.E.*, A **35** 114], which is a common and serious pest of olive in California. In 1946, a dust containing DDT, sulphur and inert material (5 : 88 : 7) was applied at the rate of approximately 200 lb. per acre on 11th July and 1st August for the control of *S. oleae*. Examination on 1st October revealed the presence of a large number of distorted scales of *P. oleae*, beneath which were mature females that had laid no eggs, the inference being that the DDT dust killed the males but not the females ; 98, 45 and 15 per cent. of the mature females on the fruits, leaves and twigs, respectively, and 32 per cent. of the total had abnormal scales. On the fruits and leaves,

more than 90 per cent. of the males that had not emerged were dead. Living males appeared to be in the second instar, and dead ones chiefly in the pupal stage.

Although satisfactory control was not obtained, the occurrence of so large a proportion of non-gravid females suggests the possibility of controlling insects by killing the males, provided that parthenogenesis does not occur and some factor makes the males easier to kill. In the case of *P. oleae,* it may be that the males were killed after they emerged and moved about, thus coming into contact with the poison ; on the other hand, they are more strongly chitinised than the females, and the presence of chitin has been shown to be favourable for DDT toxicity.

OLDHAM (H. T.) & THORNE (F. T.). **Six-spotted Mite on Avocado.**—*J. econ. Ent.* **40** no. 2 p. 279. Menasha, Wis., 1947.

A moderate infestation of *Tetranychus sexmaculatus*, Ril., was found on avocado at Carlsbad, California, in August 1946. Although this mite is a common pest of *Citrus* in the coastal areas of southern California and avocados have been planted adjacent to *Citrus* groves for many years, it has not previously been observed on avocado. Feeding was mainly confined to the under surface of the leaf, and darkened, scarred areas were formed without appreciable buckling. The mites were causing slight damage in August, but their numbers then decreased and they were of no economic importance by October. A predacious Gamasid mite was observed among them.

HAYDAK (M. H.). **Rearing Clothes Moth and Black Carpet Beetle in the Laboratory.**—*J. econ. Ent.* **40** no. 2 pp. 279–280, 2 refs. Menasha, Wis., 1947.

In the method described, eggs of *Tineola bisselliella*, Humm., are obtained by etherising adults and placing them in wide mouthed jars with a capacity of 1 U.S. pint containing 3–4 pieces of woollen cloth, 3 ins. square. The jars are closed with filter paper, fastened with a screw type rim. After 3–4 days, the pieces of cloth bearing eggs are transferred to a jar with a ¼ inch layer of food at the bottom, and arranged with ½ inch layers of food between each two pieces of cloth and about 1½–2 inches of air space at the top. The jar is covered with filter paper, preferably protected with a wire cloth of fine mesh to prevent the escape of any larvae that gnaw through the paper in search of pupation sites, and a new supply of food is added later if necessary. Adults of *Attagenus piceus*, Ol., which need not be etherised, are allowed to oviposit in jars prepared as for the moth, a jar is half filled with food and a piece of woollen cloth bearing eggs is sprinkled with food and put on top. Usually the larvae soon bury themselves in the food and the cloth can then be removed. The cultures were kept at about 77°F. and 60 per cent. relative humidity.

Commercial casein, expeller processed soy-bean flour, dried brewers' yeast and dried egg yolk were used as food for the insects, and the results obtained with various combinations of these are shown in a table. The diet recommended for both insects contains the flour, casein, yeast and egg yolk in the proportion of 65 : 20 : 10 : 5, but mixtures of the flour, yeast and egg yolk (85 : 10 : 5) or flour and yeast (80 : 20) can also be used for rearing *T. bisselliella.*

SIEGLER (E. H.). **Leaf-disk Technique for Laboratory Tests of Acaricides.**—*J. econ. Ent.* **40** no. 2 p. 280. Menasha, Wis., 1947.

Because of their small size, abundance under favourable conditions and rapid movement on the food-plant, phytophagous mites are difficult to handle in experimental work, and the author therefore devised a technique for use in

testing acaricides in the laboratory. *Tetranychus bimaculatus*, Harvey, is reared in the greenhouse on bush lima beans, leaves are removed from the plant, and suitably infested areas are cut out with a short cork borer having a diameter of 0·87 in. The leaf disks, usually five per test, are put in a petri dish containing moist cotton, removed one at a time with forceps, immersed in the stirred test material for a period of three seconds and then returned to the petri dish and kept there until examined. Counts are made of living and dead nymphs and adults, and ovicidal data can be obtained at the same time if eggs are present.

Typical results obtained where series of disks were immersed in distilled water or water containing specified amounts of Dreft or Dreft and lime-sulphur and examined two days later are given to show their uniformity.

Insect Pests.—*Agric. Gaz. N.S.W.* **59** pt. 2 pp. 88–91, 101, 8 figs. Sydney, 1948. *T.c.* pt. 3 pp. 149–152, 2 figs.

The first of these two parts of a series on insect pests in New South Wales [*cf. R.A.E.*, A **36** 305] includes notes on parasites that attack *Chortoicetes terminifera*, Wlk. [**24** 807 ; **26** 450, 629], in the course of which it is stated that a larva of the Nemestrinid, *Trichopsidea oestracea*, Westw., survived in the laboratory without food for over a year. During most of the time, it was in dry soil. The larvae of this parasite can therefore probably survive in the soil for very long periods during drought conditions. *Euploea core* subsp. *corinna*, Macleay, occurred in unusually large numbers in various parts of the State in January 1948. It was recorded mostly from oleander (*Nerium*), but the larvae also feed on other plants with milky sap, including *Ficus* spp., *Stephanotis*, *Rhynchospermum* and *Mandevilla*. Control measures are not usually necessary, but sprays of lead arsenate or DDT are recommended if required.

The second part contains notes on the bionomics of *Lyctus brunneus*, Steph., and recommendations for its control in timber [*cf.* **36** 248, etc.], together with lists, compiled by the Division of Wood Technology, Forestry Commission of New South Wales, of Australian timbers that are very susceptible to attack and of those that are immune from it, and another of some exotic timbers that have been infested.

Big Bud (Rosette) of Tomatoes and other Plants.—*Agric. Gaz. N.S.W.* **59** pt. 3 pp. 139–143, 10 figs. Sydney, 1948.

The virus disease known as big bud of tomato [*Galla australiensis* of Holmes] or virescence, which affects a wide range of wild and cultivated plants [*cf. R.A.E.*, A **32** 65–66], has been reported from all tomato-growing areas in New South Wales, but is most common to the west of the Dividing Range, where losses occur in seasons favourable to its spread. Since it is transmitted by *Orosius* (*Thamnotettix*) *argentatus*, Evans [**32** 66] and possibly by other Jassids, it is thought that the application to field crops of a 1 per cent. DDT dust, which is known to be toxic to Jassids, might prove effective. Treatments should begin when the insects are first observed in the neighbourhood and be repeated at intervals of about ten days, particularly in October and November, when infection of crops most commonly occurs. The destruction of weeds that may serve as reservoirs of the virus is also recommended.

Hely (P. C.). **Fuller's Rose Weevil** (*Pantomorus* (*Asynonychus*) *godmani* **Crotch**)**, a troublesome Pest of Citrus Trees.**—*Agric. Gaz. N.S.W.* **59** pt. 3 pp. 144–148, 2 figs., 6 refs. Sydney, 1948.

Pantomorus godmani, Crotch, was first recorded in New South Wales in 1934 [*R.A.E.*, A **22** 658] and caused severe injury to *Citrus* near Gosford in 1937.

It has since spread over a large area of the central coast and can be found in many *Citrus* orchards and on weedy ground, but has not been recorded from any other State in Australia. Its world distribution is reviewed, and the adult is briefly described. A list is given of the numerous plants attacked by the adults in New South Wales ; they include all varieties of *Citrus*, several other fruit trees, blackberry, French bean, and various garden flowers and weeds. Larvae have been bred in the insectary or taken in the field on *Citrus*, blackberry, *Chenopodium*, *Sida* and French bean. The adults feed on the leaves and the larvae on the roots.

No males of *P. godmani* are known, the species being parthenogenetic, and the females cannot fly [*cf.* **28** 189]. The weevils emerge from pupae in the soil mainly from December to March, later in dry than in wet seasons, and soon start to feed. They usually begin to oviposit in early March and may continue until May. They feed until frosts occur and some hibernate and lay eggs the following spring, but most do not overwinter. The eggs are laid in masses, usually of 20–30, between any two surfaces in contact, often leaves drawn together by spiders' webs ; the number laid per female averages 200 in about eight batches. Eggs laid in early autumn hatched in 30–57 days, and those laid in spring in about 38 days. Eggs laid in late autumn have a much longer incubation period and may overwinter. Eggs can remain viable in very dry atmospheres, but moisture stimulates hatching when they are fully incubated. The young larvae migrate to soil and feed for varying periods. Newly-hatched larvae were apparently unaffected when kept in dry tubes without food for as much as ten days. On potted orange seedlings, the larval stage of individuals hatched in autumn lasted about 260 days. The larvae are found mainly 6–8 ins. below the soil surface and near the trunks of the trees. The prepupal and pupal stages are passed in an earthen cell, and the pupal stage, in the insectary, lasted about 17 days in December and 24 days in March.

The adults gnaw large pieces from the margins of the leaves of *Citrus* and similar fibrous-leaved plants and sometimes skeletonise them ; young shoots may be nipped off and buds gnawed, but no injury to the fruit has been observed [*cf.* **3** 347], and the effect on the trees is seldom of importance. The larvae destroy the fibrous roots ; well-tended trees can apparently tolerate heavy infestation for several years, but neglected ones lose vigour more rapidly. As the fibrous roots develop most abundantly during late spring, summer and early autumn, when most of the weevils are in the pre-pupal and pupal stages, the trees can compensate for root losses suffered when the larvae are active. French beans are more severely injured and are sometimes killed, as the larvae also attack the main roots, making shallow pits close together in them. Temperate to sub-tropical conditions appear to be most favourable to the weevil, but neither larvae nor adults are unduly affected by heat, and gravid females were common in the Gosford district in January 1939 after temperatures of as much as 117°F., which caused high mortality of many other *Citrus* pests. Cold winters are unfavourable, but the insects commonly overwinter in the egg and adult stage in sheltered positions in buildings, glasshouses and rubbish.

Although clean orchard cultivation is thought to be of importance in control, considerable injury has been observed in weeded orchards. Successful control of the adults has been obtained by spraying with cryolite (10 oz. to 20 gals. water) or with an emulsified solution of DDT [*cf.* **34** 383]. Lead arsenate sprays have been of little value. Derris preparations are fairly effective, but pyrethrum sprays merely stun the weevils temporarily. Adhesive bands round the trunks will keep the weevils off the trees if low growing branches and neighbouring weeds are removed. The damage to the roots by the larvae can be offset by manuring, the planned use of fowls and irrigation to encourage the development of root fibre.

GRANDORI (R.) & GRANDORI (L.). **Infestazione di *Galeruca tanaceti* L. su piante ortensi in Lombardia.** [*G. tanaceti* infesting Garden Crops in Lombardy.]—*Boll. Zool. agr. Bachic.* **13** fasc. 3 pp. 5–8, 5 figs. Turin, 1946.

Galeruca tanaceti, L., the larva, pupa and adults of which are briefly described, damaged vegetable crops in gardens in northern Lombardy in the spring of 1946. This Galerucid does not usually attack economic plants [*cf.* *R.A.E.*, A **29** 68], and the reasons for its doing so are not known. Dusts containing 4 or 5 per cent. DDT gave complete mortality of the larvae in field tests.

MORETTI (G.) & MAURI (M.). **Esperimenti di lotta contro l'idrocampa delle risaie** (*Nymphula nymphaeata* **L.**). [Experiments on the Control of *N. nymphaeata* in Rice-fields.]—*Boll. Zool. agr. Bachic.* **13** fasc. 3 pp. 15–47, 6 figs., 20 refs. Turin, 1946.

A brief account is given of the bionomics of the Pyralid, *Nymphula nymphaeata*, L., which has caused damage to rice in Lombardy in recent years. The larvae, which overwinter in ditches and springs, float in on the irrigation water when the fields are flooded in late April and cut the young rice seedlings, feeding on the leaves and encasing themselves in the cut fragments. The younger larvae are completely aquatic, but the older ones breathe air, and can remain submerged only so long as there is a bubble of air inside their cases. The larvae that reach the rice-fields are air-breathing and they complete the pupal stage in June ; the damage to rice ceases at this time, as there is only one generation a year. Insecticides had not been used for control because of the expense and the danger to fish and frogs ; the larvae were kept in check mainly by stocking the water with carp, but this became impossible under post-war conditions.

Numerous laboratory and field experiments were carried out during 1945–46 to determine the effects of DDT and other insecticides, applied to the water surface, on this species and on other forms of aquatic life, and detailed results are shown in tables. In the laboratory experiments, small groups of larvae were kept in suitable receptacles and the dusts were sifted on to the water, bentonite being used in the controls. Two proprietary arsenicals and calcium cyanamide proved less effective than Gesarol (4 per cent. DDT) ; the latter gave complete mortality of air-breathing larvae in 2–4 and 3–5 days when applied at rates equivalent to 81–114·3 and 16·2–32·4 lb. per acre, respectively. Since some of the dust sank to the bottom, leaving irregular patches on the surface, whereas none was lost from the foliage, a measured area of leaf surface alone was dusted, but complete mortality was not obtained at rates of less than 20 mg. Gesarol per 100 sq. cm. Another experiment in which the dust was applied to leaves or to the bodies of the larvae (both air-breathing and aquatic) indicated that the dust acted mostly by ingestion, with a secondary contact action effective chiefly against the younger larvae. In the field, contact would be rendered difficult by the presence of the case. In further tests, equal toxicity was shown by pure DDT and Gesarol at an equivalent rate on leaves, and by Gesarol and Gyron (a floating dust containing 5 per cent. DDT) on water ; the latter remained in a homogeneous film on the surface for at least seven days and showed superior adhesion to foliage, so that its effect should be more lasting in the field. Chloretone and several DDT derivatives were tested, but were of no value. A mineral oil fraction with a boiling point of 300–350°C. applied to the water surface with a pipette at a rate equivalent to 0·36 gal. per acre apparently killed all the larvae, but some pupae survived. A dust of bentonite and hexachlorethane (1 : 1) gave good control at high concentrations, but its effects were not lasting. A preparation containing 80–85 per cent. barium fluosilicate was as toxic, weight for weight, as Gesarol, but its high specific gravity caused it to sink too rapidly for practical

use. In all small-scale experiments, larvae in the control vessels tended to die after a few days, when the water became contaminated with decaying organic matter.

The oil was not injurious to tadpoles of *Rana esculenta*, even at concentrations high enough to scorch the rice stems. Gesarol killed the tadpoles in small receptacles, but in large ones in the open air a concentration lethal to larvae of *Nymphula* (350 mg. per 5,175 sq. cm. [about 5·6 sq. yds.]) killed very few tadpoles. It was also tested against numerous aquatic organisms, chiefly Arthropods, with varying results, which are given. In experiments with fish, 12 examples belonging to four different species were placed in each of two vessels of water with a surface area of 5,175 sq. cm. and a depth of 35 cm. One of these was dusted with 940 mg. Gesarol. One fish died in each vessel, but the remainder were still healthy after 16 days. The experiment was repeated with 1 gm. Gyron, and all the fish survived.

Field tests were begun in July 1945, when Gesarol dust was applied at the rate of 1 oz. per 24 sq. yds. to the basin of a spring containing a dense growth of *Potamogeton natans* heavily infested with air-breathing larvae of *Nymphula*, as well as many other aquatic insects. After four days, the weeds were removed for examination, and 753 empty cases and 10 containing dead larvae were found. There was no fresh damage to the weed, and it was concluded that the larvae had left their cases to die. Insects and fish at the bottom of the pool were unaffected. A month later, the pool was infested by young (aquatic) larvae of *Nymphula*, and the leaves were dusted at the rate of 1 oz. per 60 sq. yds. These floating leaves were not attacked, and after two days numerous dying larvae were observed, but the control of aquatic larvae did not appear to be complete. In September, a part of Lake Pusiano where water lilies grow was heavily infested by aquatic larvae of *Nymphula* and was dusted with Gesarol. In four days the dust on the water had been carried away by the current, but that on the leaves remained. No perceptible control of the larvae resulted, and it was concluded that a floating dust was useless against aquatic larvae in moving water.

In May 1946, three tests with Gyron were conducted in rice-fields near Vercelli. In the first, a field of nearly 2½ acres in which the depth of the water averaged nearly 7 ins. and the height of the rice plants one foot, Gyron was applied at a rate of 5·4 lb. per acre. In addition to numerous larvae and some pupae of *Nymphula*, other insects, including Trichopterous larvae (*Triaenodes bicolor*, Curt.) [*cf. R.A.E.*, A **22** 506], and a few small carp were also present. The dust was blown by the wind to one side of the plot, but a great number of the cases of *Nymphula*, all empty, were found on the next day, and the *Triaenodes* larvae were also destroyed. No dead carp were observed. In the second test two heavily infested plots each 600 sq. yds. in area were dusted at the rate of 14·4 lb. per acre. The water outlet had become blocked, so that the dust remained evenly distributed, and this suggested the possibility of temporarily stopping the flow during control operations. Almost all the cases of *Nymphula* collected on the next day were empty or contained dead larvae, and the destruction of *Nymphula* seemed to be complete a week later. A few dead frogs were found, but there was no damage to the plants. The third test, also on small plots, gave inconclusive results owing to the small population of *Nymphula*.

Langford (G. S.). Ed. **Entoma. A Directory of Insect and Plant Pest Control.** 7th edn., 416 pp. College Park, Md., Eastern Br. Amer. Ass. econ. Ent., 1947. Price $1.00. Mailing charge 20 *cts*.

In addition to the information in earlier editions of this directory [*R.A.E.*, A **35** 301, etc.], the seventh includes a list of the senior officials of the U.S. Bureau of Entomology and Plant Quarantine.

Mickel (C. E.) & Standish (J.). **Susceptibility of edible Soya Products in Storage to Attack by** *Tribolium confusum* **Duv.**—*Tech. Bull. Minn. agric. Exp. Sta.* no. 175, 28 pp., 9 figs., 3 refs. [St. Paul., Minn.] 1946.

When the production of edible soy-bean products was greatly increased in the United States in 1942 and 1943 and the possibility of distributing and storing them throughout the world was contemplated, detailed investigations of the insects that were likely to damage them were begun in Minnesota. *Tribolium confusum,* Duv., was the first to be tested and data were obtained on its development and reproduction when limited to certain types of processed soy-bean flour and soy-bean grits ; with such information it is possible to predict the chance of infestation of soy-bean products under the various conditions that might exist in warehouses. Seven different types of soy-bean flour and grits were compared with a mixture of whole wheat flour and brewers' yeast (95 : 5) at temperatures of 25 and 35°C. [77 and 95°F.], which approximate to average and maximum temperatures in storage, and at relative humidities of 30, 50 and 80 per cent. The insects were reared individually and observations on their progress were made daily. The results are given in detail and illustrated on graphs.

The following is based on the authors' summary. Although *T. confusum* is a much less serious pest of soy-bean flours and grits than of cereal products, it can attack all those tested and may cause some damage when the relative humidity in storage is higher than 50 per cent. Full-fat soy-bean flour is likely to be more heavily infested than other soy-bean flours and grits. Low-fat-extracted soy-bean flour and low-fat-extracted fine soy-bean grits are the most attractive to the females for oviposition, but both these materials are less favourable for the development of the insect than full-fat soy-bean flour. Any soy-bean flour or grit is more likely to be infested and damaged by *T. confusum* when combined with cereals, either in unfinished forms such as pancake flours, or in the finished form as baked goods, than in their original processed form. The rate of larval development is greatly decreased in soy-bean flours and grits, and there is a conspicuous increase in the number of larval instars.

Papers noticed by Title only.

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